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2015

Feb 2015
Issue 412



HOW
TO

HACK GOOGLE'S CHROMECAST!

Android expert Darren
Yates shows you how



2015 TECH PREVIEWS

We uncover all the big
PC & tech changes
coming this year



WHY YOU NEED A VPN

It's not just Netflix:
Protect yourself
from metadata
snooping now!

PERFECT PC UPGRADES

THE EXPERT GUIDE TO REVITALISING YOUR DESKTOP, LAPTOP
OR BUILDING A WHOLE NEW PC FROM SCRATCH!

TECH HOW-TOs MADE EASY

- Create a Linux-powered media server
- Secure your Mac files
- Safely clean the Windows Registry
- Build your own Raspberry Pi OS

HOTTEST NEW GEAR

- Best products of CES 2015
- 40-inch 4K monitor for \$1,000!
- ASUS's toughest motherboard ever
- Latest apps!

CHILL OUT!

We compare the latest no-mess, self-contained liquid coolers! Which ones will keep your CPU cool and quiet?



Future

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02

msi®

MSI recommends Windows.



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FIPP



The perfect time to upgrade

APC's editor argues that there's never a 'best time' to upgrade — but that you shouldn't let that stop you regardless.

After looking through our APC archives, I think I can say without much doubt that this issue offers our biggest-ever PC upgrade guide. In it, we've not only provided specific product recommendations and attempted to help you decide what's actually worth upgrading from, but we've also aimed to answer broader questions for you, like 'How much RAM is enough?' and 'Do I really need to spend \$500 on a graphics card?' (The answer to those is, respectively, 'around about 8GB', and 'maybe'.)

Is there ever a perfect time to upgrade your PC? The answer to that is essentially no... it's a tech truism that, be it PC components, smartphones, TVs or fitness bands, there's always something better and brighter just over the horizon. That doesn't mean you shouldn't, on occasion, wait it out for a month or two. That's part of why we've incorporated a series of '2015 tech previews' into this month's upgrade articles — this way, you can easily decide whether or not now is the time for you to upgrade a specific component, or whether you should wait a little longer for that 'Next Big Thing'.

My personal feeling is that now's as good a time as any to make the

leap to a new rig — depending on how old your current PC is, of course. Motherboards with the Z97 (et al) chipset may be the last generation of Intel boards to use DDR3 memory, and with DDR4 and Haswell-E processors still both a wee bit too costly for my own liking, I recently decided to put together a mini-ITX Z97 system based around many of the same parts as our 'perfect PC' on page 64. The upcoming desktop Broadwell CPU line, expected around the middle of the year, will stick with the Z97/H97 platform for motherboards, so there'll be room for me to upgrade my CPU (if needed) down the track too. Based on my history though, it's more likely I'll just sporadically upgrade my graphics card, storage and monitors as new and interesting gear lands (when the budget's willing, of course) before doing a full system overhaul once DDR4 has fully taken root (and become a bit more affordable). ■



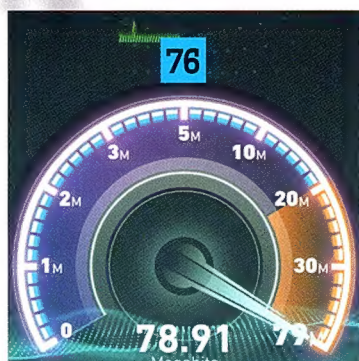
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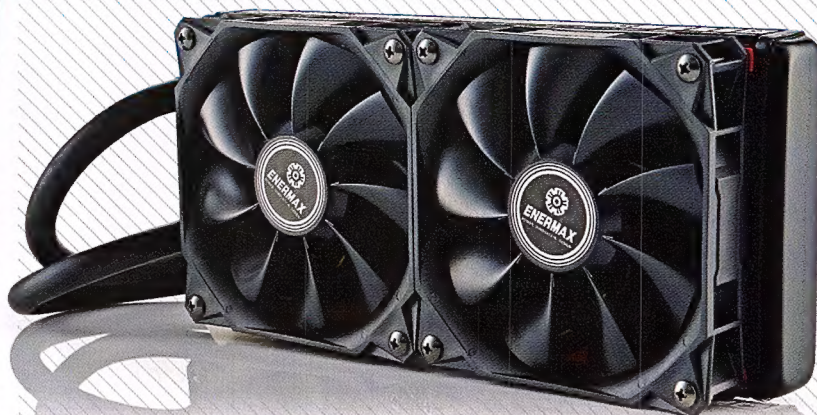
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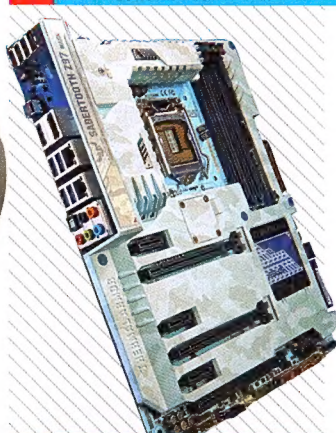
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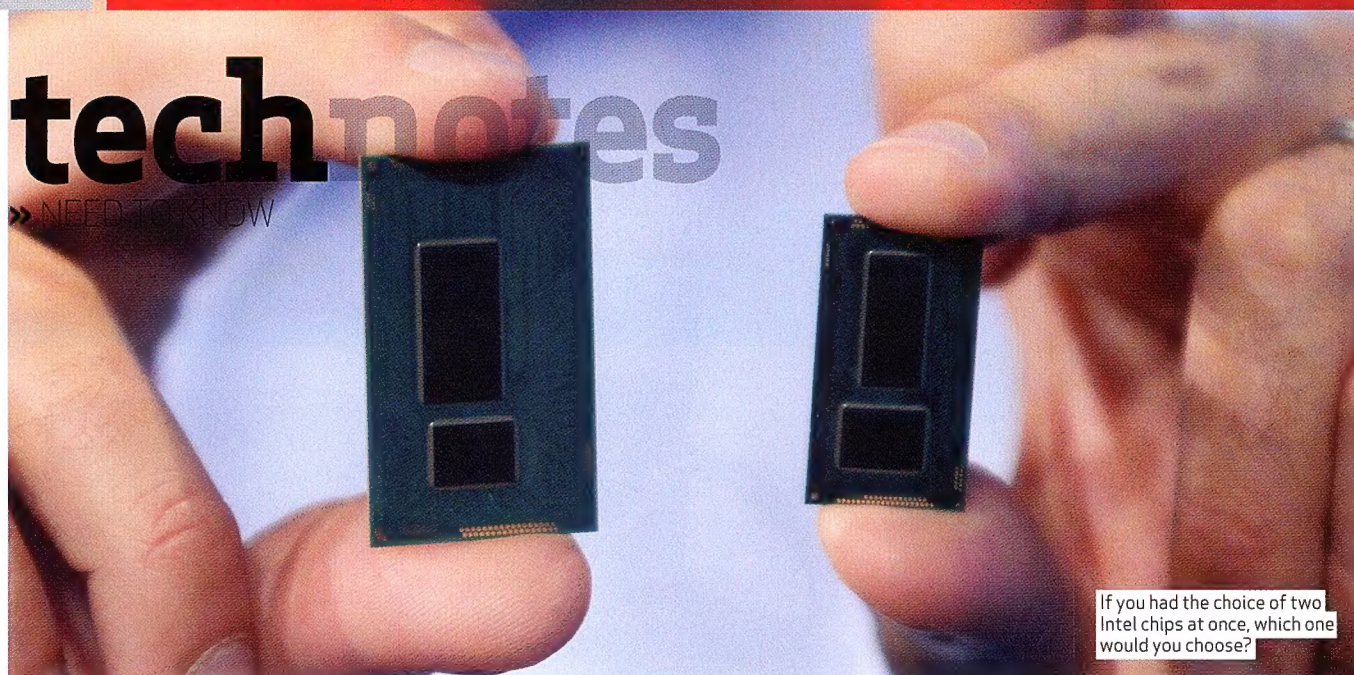
News from the world of geekdom.



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If you had the choice of two Intel chips at once, which one would you choose?

Broadwell and Skylake CPUs to launch in June?

Will Intel release not one but two new lines in time for Computex?

Intel has left us a tad confused about what's going on with this year's new processor and chipset launches. Intel's big chip news at the recent CES is that Broadwell CPUs are finally here. But it's all in the same way the 14nm Broadwell processors were released before Christmas, so we're only seeing a few low-power mobile SKUs trickling out in January.

There will be higher-powered mobile quad-cores, with the latest Iris Pro graphics technology, but that will be late January or early February. But what of the desktop parts? Where are our 14nm desktop chips, and where are the socketed Broadwell and Iris Pro CPUs we were promised at IDF this year?

Well, according to a recent conference call with Intel, the Broadwell desktop parts will be arriving in the middle of this year. That's including the unlocked K-series, so we should expect the new

performance chips some time around Computex in June. That's quite late. Most analysts had been expecting a launch around March or April – an understanding mostly born out of the announcement at IDF 2014 that the brand new Skylake Core architecture was due in the second half of 2015. Surely Intel wouldn't be releasing Broadwell and Skylake desktop chips at the same time, would it?

It turns out that Intel might do exactly that. Speaking with other manufacturers, they are expecting to see the Z170 motherboards – with the new Skylake LGA 1151 socket and DDR4 support – being launched at Computex too. These boards are incompatible with any current CPU – the Broadwell desktop chips will be working in the standard 9-series boards, with Skylake being the only one to take advantage of the 100-series chipset.

So, what gives? Well, it looks like the plan might be to release the unlocked Broadwell K-series chips. Then the standard Skylake-S parts. That would then leave the Skylake-K overclocking-friendly chips as a victim of Intel's marketing bods, left out of reach on the tech shelf until it decides it's sold all the Broadwell-K chips it can.

We knew there would be some overlap, but if Intel goes for this strategy it begs the question of why anyone would be interested in buying a Broadwell chip when Skylake is ready and waiting. Intel's response was that people wanted a socket-compatible upgrade path, which is what the Z97/Broadwell platform offers. Our big fear is that we end up with a three-tier setup. The Skylake platform might then end up being priced artificially high as a consequence, benefiting none of us.

Dave James



Hacktivist group Anonymous digitally targets terrorists

Claims to have suspended Twitter accounts and web sites of extremists.

Following the widely-condemned attack on the offices of French satirical publication *Charlie Hebdo*, online activist group Anonymous posted a press release on January 7th vowing to take action against the perpetrators. Opening with condolences to the families of the 17 killed, the statement stressed the group's belief in the importance of free press and expressed, directly to terrorists, Anonymous's catchcry: "We are Anonymous. We are legion. We do not forgive. We do not forget. Expect us." Updates by Anonymous followed on the group's official Twitter account, with photos of members (wearing Guy Fawkes masks) attending #JeSuisCharlie gatherings around the world, including one in Sydney. They also requested links to the social media accounts of terrorists to be sent in, so they could disable them. The requests seem to have been answered. On January 10th, the French web site ansar-alhaqq.net (said to associated with extremists) had been removed along with the hashtag #TangoDown. By the 14th, Anonymous claimed to have suspended 200+ presumed terrorist's Twitter accounts. JB



Lizard Squad hackers exploit home internet routers

Malicious code infects routers, turning them into internet attack bots.

Lizard Squad — the group claiming responsibility for the PlayStation and Xbox network attacks that left many gamers offline over Christmas — were running their DDoS attacks through vulnerable internet routers, it has emerged. Krebs on Security, an internet security blog which was also run offline by the group in early January, took the time to look into how the operation functions. After investigating the malware powering a botnet that facilitates the Lizard Squad's DDoS attacks, Krebs revealed in a blog post that the controller originates from a domain hosted in Bosnia. The malware used dates back to early 2014, and contains code that exploits vulnerabilities in internet routers, turning them into stresser bots that can be used to target and overload specific sites. Many consumer internet routers are wide open to exploitation due to unpatched security holes, a problem that's often compounded by users leaving default router passwords unchanged. The Lizard Squad attacks were essentially an advertising campaign promoting their 'booter' and 'stresser' services, that they claim can take down web sites for paying customers. Joel Burgess



SSDs are proving to last a lot longer than first thought.

SSDs that last 1,000 years

New tests reveal the staggering endurance of even current-gen solid-state drives.

Solid-state storage drives (SSD) are relative newcomers to the storage scene compared to their mechanical hard disk siblings, so a full understanding of their long-term reliability is still developing. In the absence of a DeLorean equipped to race back and forth in time, the next best way to test SSDs for longevity is to bombard them 24/7 with reads and writes. It turns out that such a test is taking place, with two SSDs having survived 2 petabytes of write tests so far.

The curious folk at TechReport started testing a batch of SSDs a year ago. They kicked off with the Corsair Neutron Series GTX, Intel 335 Series, Kingston HyperX 3K, and Samsung 840 Series. The two left currently standing are the Kingston and Samsung drives, both of which surpassed 2 petabytes of writes and are still going strong. Most consumer SSDs will process up to a couple of terabytes every few years. So, to write 2 petabytes of data under

normal use, you'd be looking at about 1,000 years of real-world testing.

Luck of the draw does seem to play a factor however, as TechReport's first HyperX 3K SSD died after reaching 728TB. Nevertheless, that's a lot of data, and like the other four drives that died during the endurance test, it vastly exceeded its official specifications. "More importantly, the drives all survived far more writes than most users are likely to generate. Typical consumers shouldn't worry about exceeding the endurance of modern SSDs," TechReport writes.

Granted, this is just one test, but the results are encouraging for anyone who worries about their SSD's lifespan. They're also a huge improvement from the early days, when every other bootup felt like Russian roulette. Well, almost. Time, then, to upgrade SSDs from 'emerging' tech to 'tried, tested, and recommended'? Absolutely. Paul Lilly

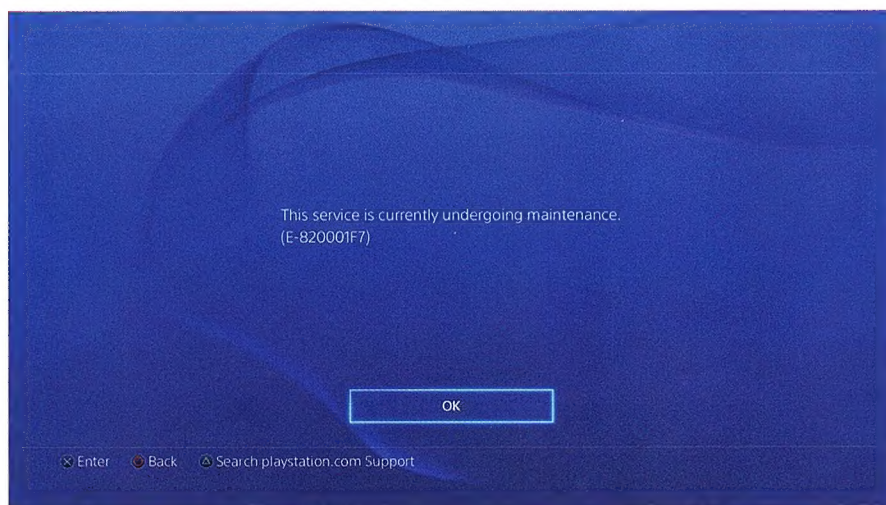
Fallout continues over Sony Pictures hack

FBI still confident that North Korea is behind the cyber attacks.

The US government has now determined that North Korea was behind the vicious cyber attacks on Sony Pictures that we reported on last month, which caused the studio to partially pull its film *The Interview* from its intended wide theatrical release.

FBI director James Comey has cited "sloppy" IP masking by the hackers (who call themselves the 'Guardians of Peace') as the factor that led investigators to trace emails and messages sent to Sony employees back to hackers in Hermit Kingdom.

As the internet infrastructure used in North Korea is more akin to a closed intranet controlled by the government, outside access to a North Korean IP address is almost impossible to acquire. This is why the FBI, along with the NSA and Homeland Security, believes that the country officially authorised the hacks. The *Interview*, which was eventually released on Christmas Day in the US across various video-on-demand services, earned \$31 million in digital sales in its first week, making it the highest grossing online film of all time. A wide international release is on the way. SL



\$2.99

Web site shutdowns for the bargain price of US\$3

During the Christmas of 2014, both the PlayStation Network and Xbox Live were offline for a number of days, believed to be due to ongoing distributed denial of service (DDoS) attacks. Hacker group Lizard Squad has since claimed responsibility, stating that the attack was designed to act as a marketing campaign for its new web site, Lizard Stresser. The web site offers users a DDoS attack on any web site, resulting in a takedown ranging from 100 seconds (US\$2.99) to eight hours (US\$69.99). While Lizard Squad claims that the service is a legitimate tool that allows web site owners to test their site's ability to withstand an attack, the web site also promotes the ability to attack Skype and Steam accounts, with more tools promised to be 'coming soon'.

345 million

Google's mission to blacklist pirate sites

While it's no secret that people love to download content illegally over the internet, recent data has revealed the extent to which copyright holders are trying to prevent it. In 2014 over 345 million applications were submitted to Google requesting the take down of pirated links from its search engine. This represents a 75% increase from the year before and a massive contrast to the 2008 figures, when only a few dozen takedown requests were made. With the company now responding to over a million applications each day, Google has made its own attempts to reduce the issue, having altered its search algorithm last October to significantly downrank sites providing access to potentially copyright-infringing materials.

18.8%

Apple sued for misleading storage specs

While much of the recent criticism towards Apple has focused on the durability of its devices (see 2014's iPhone 6 Plus 'bendgate' kerfuffle), the company's mobile OS has also been placed under scrutiny, with a couple in the US preparing to sue Apple for what they see as the company misleading users about the actual storage that's available for use. The lawsuit is particularly focused on the size of Apple's latest iOS 8 release, which requires a whopping 5.7GB of free space for iPhone users and up to 7GB for iPads (unlike previous updates, which typically required around 1-2GB of free storage). In the case of the cheapest compatible iPhone models — consisting of only 16GB of storage — 18.8% of that space is reserved for the iOS 8 operating system, meaning users only really have 13GB available to store photos, videos and other content. On the bigger iPhone 6 Plus, that rises to 21.3% of the included storage being taken up by iOS 8, leaving users with only 12.7GB to use.

5%

A monumental flaw in Google's mobile OS?

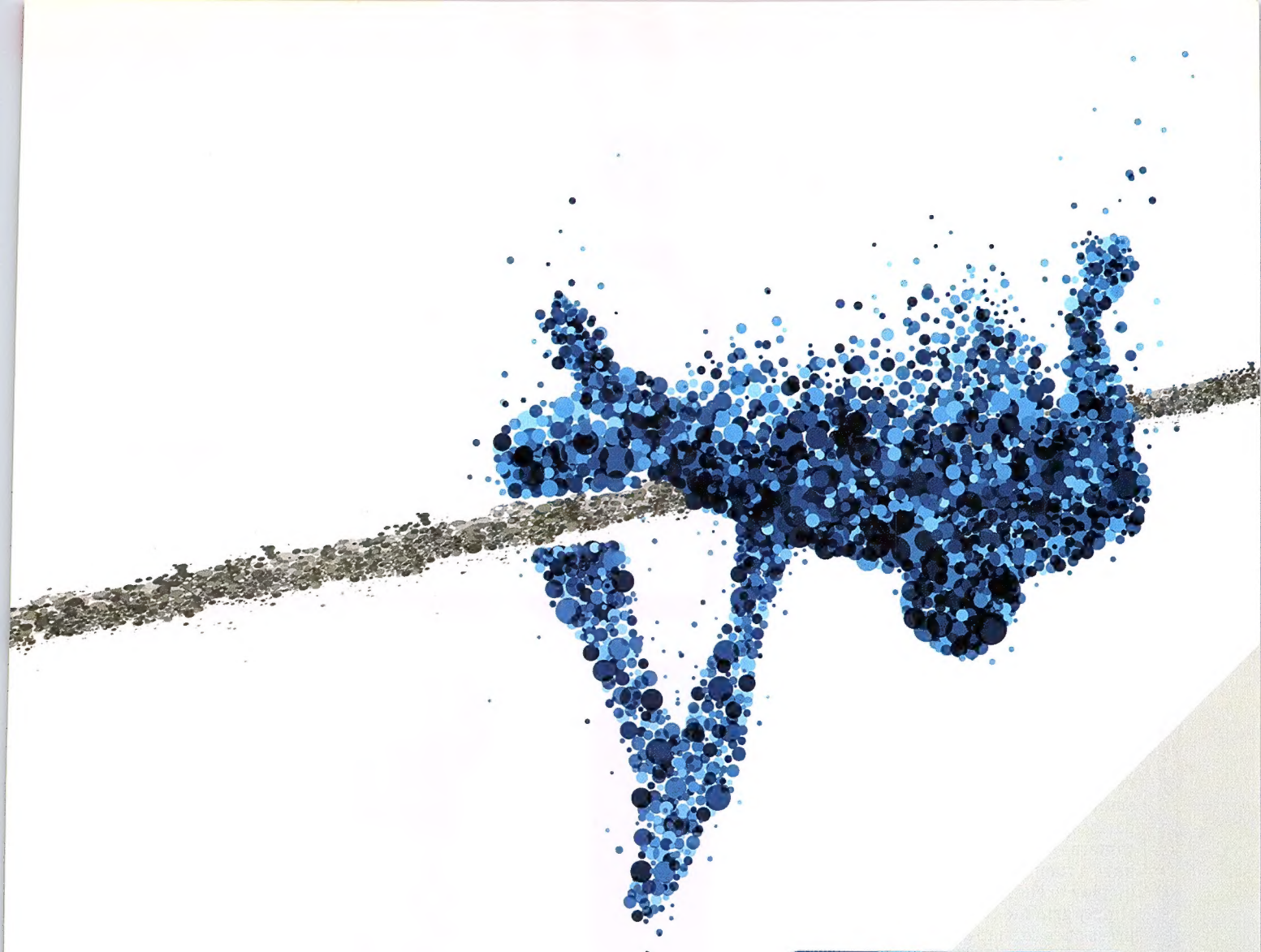
In figures that perhaps suggest just how tightfisted we are when it comes to paying for smartphone apps, mobile gaming developer ustwo (the creators behind the 2014 hit Monument Valley) has revealed that only 5% of those who installed the game on Android actually paid for it. While the game costs \$4.99 to purchase, the vast majority of Android users obtained the app illegally, installing pirated versions of the game from web sites outside of the Google Play Store. While the developers claim to not be upset by the data, it's not particularly encouraging if you're a developer considering making paid apps or games for Google OS. While the more locked-down nature of iOS means it's a slightly more pirate-proof platform, the Monument Valley piracy numbers were still surprisingly high on Apple's OS: only 40% of installs were paid for.

360°

YouTube to provide native support for 360° video

French company Giroptic has revealed that its world-first 360° full HD camera will be natively supported by YouTube. While other 360° cameras typically require users to view footage from a dedicated app or site, footage from Giroptic's 360cam will be fully navigable within YouTube's interface — both on a web browser as well as on mobile devices. Also nifty is that footage will be able to be upload to Google Street View. Having raised \$1.4 million on Kickstarter last year, the device is set to be released sometime in 2015. ■





WANT HIGHER PC PERFORMANCE?

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You've been hearing about what SSDs can do to jump start PC performance for a while now. But you haven't made the leap yet. Why, what is holding you back? Cost? Enter the all-new OCZ ARC solid state drive series. Known for its innovative enthusiast-grade SSDs, OCZ designed the ARC series to offer everyday users an excellent value while still leveraging the proven technology found in our flagship SSDs for a robust performance and reliability feature-set. Crossover...no faith needed with this leap.

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technotes

» GEAR WE WANT



EARIN

US\$199 | EARIN.COM

Earin is a set of tiny wireless earbuds that claim to be the world's smallest. They sport Bluetooth 4.0 LE and include a compact metal capsule that both stores the earbuds and doubles up as the charger. Just place the earbuds in the capsule and they'll be charged automatically and ready for listening any time. Too often earbud/headphone cases are just considered 'safe storage'. Here the case actually has a use beyond simply protection. At just 5g for the pair, they should hardly feel like they're in at all, too, and there's an iPhone/Android app that will allow you to tweak various playback features while the earbuds are in. The first allotment had sold out at the time we went to print; they should hopefully be back in stock by the time you read this.

HTC RE

\$250 | WWW.HTC.COM

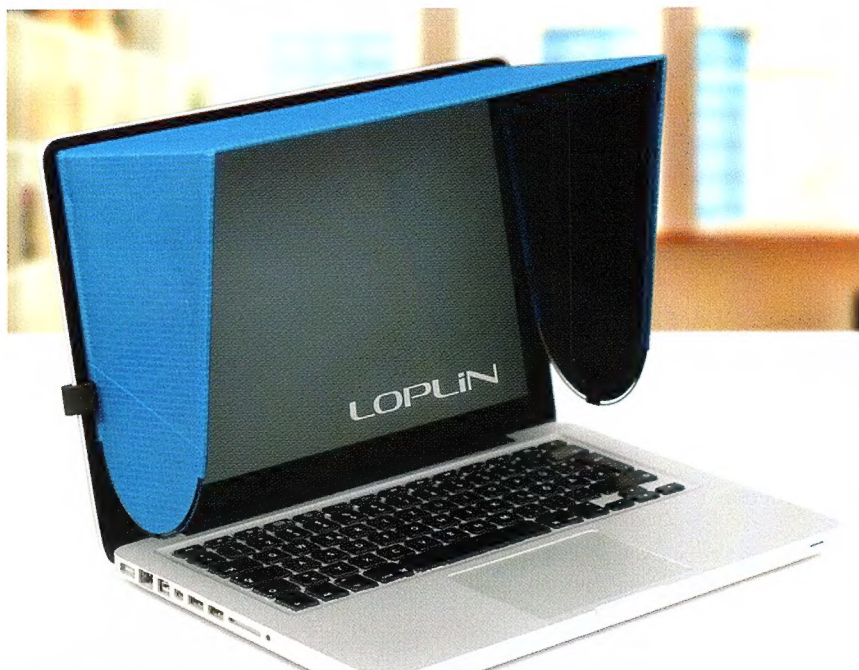
Ever missed an awesome moment because you were fiddling with your smartphone's camera app? The periscope-shaped HTC Re handheld camera is built for speed — it doesn't have a zoom, a mode dial, or even a display to check your photos. You simply grip the HTC Re in your fist, press once to snap a 16MP still and press a little longer to start shooting a Full HD movie. There's even a slo-mo mode and the ability to live-stream footage to YouTube. Portable and durable, the Re could be a convenient way to snap and record video. But that price... Ouch.



THE LOPLIN HOOD

£43 | LOPLIN.COM

The Loplin Hood is a Kickstarter project that blocks flare light and prevents uninvited viewing on your laptop — or a 11-, 13- or 15-inch MacBook, more specifically. Much like the Smart Cover for iPads, the Loplin Hood uses the MacBook's internal magnets to clip on tight and will fold away in seconds. It's manufactured from an ultra-thin fabric and uses a self-supporting structure of carbon-fibre rods (like a kite) to snap into place and stay rigid. After use, it can be easily stored inside your MacBook's sleeve or bag; just pull it off and fold the two sides in. For something that's perceived as being cumbersome, the Hood looks like it should be relatively hassle-free. You can choose from slate, red, blue and green colours. If it gets off the ground on Kickstarter, it should be shipping by April.





AMP CASE FOR IPHONE

\$114 (INCLUDING SHIPPING | AMPAUDIO.COM

No smartphone outputs sound as well as we'd like via the built-in speakers; even the best sound weak and flat next to a real set of speakers. The Amp is a combo protective case and battery extender designed to also give you higher quality external audio as well as tweaking the real world's sound to suit your environment. The Amp can apparently use dynamic noise reduction to alter the audio output to suit where you are and what you're doing. For commuters especially, this is exactly the type of iPhone gadget that will make a world of difference. And you'll get up to a 25% battery boost with it too — not a bad little bonus! It's available for pre-order now.

SOMABAR

US\$699 | WWW.SOMABAR.KICKSTARTER.COM

Somabar won't listen and nod along to your problems in the way the robotic bartender of our dreams would, but it makes complex cocktails in just five seconds, so it gets a pass anyway. Fill its six tanks with ingredients of your choice, then choose your preferred drink from its iPhone app and it immediately starts measuring and mixing as needed, popping the result in your waiting glass. Its Kickstarter funding was successful, and the first units are due to ship in July, so (touch wood) it should hopefully be able to order for non-backers around that time. Cheers!



WI-FI COFFEE MACHINE BY SMARTER

£130 | SMARTER.AM

The first bean-to-cup Wi-Fi-enabled coffee machine, from the makers behind the iKettle. Using the accompanying iOS or Android app, this is for those who like their coffee black, but it'll brew it at exactly the right temperature from freshly ground real beans — seriously, how has the human race lived without it this long? It can even wake you when your morning brew is ready, let you know when it needs refilling, or even ask you if you want it to make you a cup of coffee when you enter the house, using its 'welcome home' mode. There's no word on an official Aussie release date, but the iKettle is available locally, so hopefully this one'll make it over too. ■

CES

THE MOST INTRIGUING REVEALS

WE UNCOVER OUR FAVOURITE GEAR, GADGETS AND PCS WHICH WILL SHAPE THE NEXT 12 MONTHS OF TECH – AND BEYOND. TIM BOTHWELL

It's the one week of the year where tens of thousands of technology experts converge in the city of Las Vegas to be immersed in a world of unique and innovative tech. The Consumer Electronics Show (CES) is the industry trade show that gives thousands of companies the opportunity to present their exciting (or otherwise) products to investors, journalists and diehard fans, hoping that their product will be the start of the next technological revolution. Not only is it small companies that present at these shows, with technology giants such as Sony, Intel, and Samsung all demonstrating new products that they hope will lead the way for future technology. In this article we've scoured the trade show to find what we believe to be the most important products that could redefine the way we use technology in our daily lives.

NEW PCS
INTEL COMPUTE STICK
THE (TINY) SHAPE OF THINGS TO COME?

EXPECTED RELEASE: MARCH (US)
PRICE: WINDOWS, US\$149; LINUX, US\$89

While desktop PCs unarguably provide more processing power than you'll find in a mobile or a laptop, the Intel Compute Stick shows just how good we've gotten at shrinking down the basic PC components. Similar to the

ARM-powered Android devices that've arisen over the last two years, Intel's PC-on-a-stick is only slightly larger than the typical USB drive. The device will come in two flavours: one with Windows, consisting of 2GB of RAM and 32GB of flash storage and the second running Linux featuring a lesser 1GB of RAM and 8GB of flash storage. Both devices feature a

quad-core Atom processor, Bluetooth 4.0 and 802.11b/g/n Wi-Fi, with inputs including full-size and micro USB ports, as well as a MicroSD slot to add more storage, with display output provided via HDMI.

MSI GT80 TITAN
THE GAMING LAPTOP WITH A REAL MECHANICAL KEYBOARD.

PRICE: FROM US\$3,600
RELEASE: OUT NOW (US)

While CES is known for its endless array of new and innovative products, there's also a fair bit of work going towards improving existing technologies or combining old ones in new ways – and it's the latter that MSI has gone for with the GT80 Titan. This titanic gaming

laptop has the unique inclusion of a built-in Cherry MX Brown mechanical keyboard. Featuring backlit LED keys that are recessed so as not to interfere with the screen, the keyboard even includes swappable gold-coloured WASD keys. Other components of the laptop are similarly impressive, with the Titan featuring a Core i7 processor,



The HP Stream Mini is competing for a place in your lounge room.



Intel was showing its latest PC on a stick unit.



MSI were focused on bringing gaming elements to the Titan, including the mechanical keyboard.



The Lenovo LaVie is lighter than Air. By quite a bit too!

dual Nvidia GeForce GTX 980M graphics chips, two RAIDed 128GB SSDs as well as a massive 1TB hard drive, with the latter drives easily accessible underneath a removable plate. One thing you won't get much of here is portability, with the massive 18.4-inch screen size adding up to a total weight of 5kg.

HP STREAM MINI HP JOINS TEAM NUC.

PRICE: US\$180 (32GB), US\$320 (500GB)
EXPECTED RELEASE: OUT NOW IN THE US;
AUSTRALIAN RELEASE DATE TBC

Thanks to tiny units like Intel's NUC boxes and Alienware's Alpha Steam Machines, the PC's starting to look far more comfortable in the living room — it's now possible to hide a fairly full-featured little unit in with all your other entertainment gear. The Stream Mini is HP's attempt to tap into this prospective market, and it doesn't hurt that it comes in at a fraction of the cost of a typical PC set up. Measuring only 2-inches tall, the basic US\$180 version of the Mini features a 1.4GHz Intel Celeron chip, 2GB of RAM, Gigabit Ethernet, Bluetooth 4.0 and 802.11n Wi-Fi, with a more powerful (and expensive) model adding a 500GB hard drive along with other higher-end features. Inputs include four USB 3.0 ports, an SD card slot and 3.5mm headphone jack, with both HDMI and twin DisplayPort outputs provided to connect the device to your TV or monitor. While the basic Stream Mini only has a measly 32GB of storage onboard, a 2-year subscription to Microsoft's OneDrive is included, giving you an extra 200GB of cloud storage, should you need it.

DELL XPS 13 WHEN IS 13 INCHES NOT 13 INCHES?

PRICE: FROM \$1,499
EXPECTED RELEASE: OUT NOW IN THE US;
AUSTRALIAN RELEASE DATE TBC

In what Dell claims to be the world's smallest 13-inch laptop, the XPS 13

features a borderless display that's effectively been squeezed onto an 11-inch laptop chassis. This new generation XPS 13 features a 1,920 x 1,080 edge-to-edge 13.3-inch display, with only a 5.2mm bezel on the top and sides. Weighing in at only 1kg, it's fairly aesthetically pleasing and features a classy aluminium finish. While the cheapest \$1,499 version lacks a touchscreen, it's fairly on par with other Windows ultrabooks, with an Intel Core i3 processor, 4GB of RAM and a 128GB SSD. What's perhaps most impressive, however, is the claimed battery life, with Dell promising up to 15 hours of use courtesy of a new Broadwell processor and a power saving Sharp IGZO display.

LENOVO LAVIE Z THE ULTRABOOK THAT'S LIGHTER THAN AIR (THE MACBOOK AIR, THAT IS).

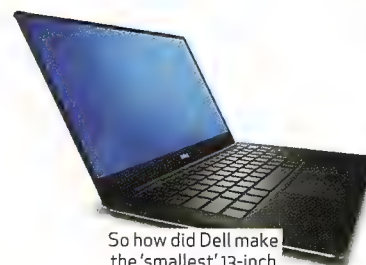
PRICE: US\$1,299; WITH
TOUCHSCREEN, US\$1,499
EXPECTED RELEASE:
MAY 2015 (US)

For a lot of us, a major factor when considering a laptop is weight. That's something Lenovo has absolutely nailed with its new 13-inch LaVie Z, which weighs in at only 770g — or around half that of the equivalent MacBook Air. Physically, it's only 16.9mm thick and has a light yet durable magnesium-lithium alloy body, with both the keyboard and display panel embedded directly within the chassis. The screen features a 13.3-inch display — and like the above Dell, a touchscreen is an

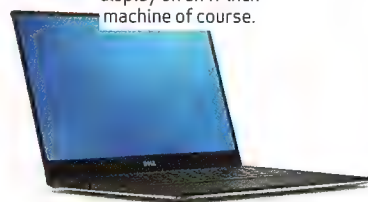
optional extra. With the lightness of the LaVie Z, you'd be forgiven for questioning its power, although surprisingly, it features a latest-generation Core i5 processor, 4GB of RAM and an adequate 128GB SSD. Battery life is good but not class-leading, with Lenovo claiming around 6 hours.



Acer's Chromebook 15 is one of the largest around.



So how did Dell make the 'smallest' 13-inch laptop on the market? Put a borderless display on an 11-inch machine of course.



ACER CHROMEBOOK 15 IT'S A BIGGIN.

EXPECTED RELEASE:
FEBRUARY (US)
PRICE: FROM US\$249

With Chromebooks slowly but surely becoming a popular alternative to Windows and Mac laptops, Acer used CES to show off what will be one of the largest Chromebooks on the market, featuring a full-HD display sizing in at 15.6-inches. While many may be put off by the Chrome OS due to its limited offline functionality, this one's well-positioned for watching movies and YouTube videos thanks to that larger-than-average screen. What's more, that price of US\$249 nets you some decent specs elsewhere; this base model features a

5th-generation Intel Core i3 processor, 2GB of RAM and 16GB of internal storage. Also good is the battery life, with the Chromebook promising up to 8 hours between charges. One issue we have with this device is portability — while its under an inch thick, its 2.2kg weight means it's a bit trickier to lug than its smaller siblings.

NVIDIA
TEGRA K1

NVIDIA
TEGRA X1

Chips & technologies

INTEL BROADWELL

THE CHIPS THAT'LL LIKELY POWER YOUR NEXT LAPTOP AND DESKTOP.

PRICE: VARIES

EXPECTED RELEASE: THROUGHOUT 2015

While ARM has the smartphone market sewn up, Intel chips are still being crammed into countless electronic devices — and it's hoping its new range of chips will help it spread even further. Intel's latest generation of Core processors — codenamed Broadwell — are the first time the company is giving a complete refresh to all aspects of its consumer CPUs, unveiling 14 new processors, including the fifth generation of its i3, i5 and i7 chips, while also expanding its lower-end Pentium and Celeron ranges. Intel has continued to focus on improved power efficiency and maximum mobility with the new parts, a number of which are already being used in the latest ultra-slim convertible devices. In comparison to its previous generation of Haswell CPUs, the company is promising up to 30% better battery life, up to 22% in improvements for 3D graphics rendering, and up to 50% increase when it comes to video encoding.

NVIDIA TEGRA X1 PROCESSOR

THE GREEN GPU GIANT TAKES TO THE ROAD.

PRICE: N/A | EXPECTED RELEASE: TBA

Nvidia continues to be a leader in gaming-focused devices, but its just-announced next-gen chip won't just be featured in gaming-oriented devices, but in cars too. Promising twice the performance of its previous K1 chip, the X1 features 256 GPU cores and an eight-core CPU, which can handle 4K video at 60Hz while promising incredible mobile graphics, and support for the same game engines that its 900-series graphics cards are capable of running. Nvidia also sees the X1 as the future in motor vehicles, unveiling the 'Drive PX' — a device powered by two Tegra X1s that's billed as an 'autopilot car computer', which will be aware of everything happening in and around the car via input devices such as reverse and radar cameras. It's this smart computer that Nvidia believes will play a part in the future of driverless cars.



The HP ZVR is still in prototype stage, but its 3D skills look promising.

PC PERIPHERALS

SAMSUNG S34E790C

PC SCREENS GET BENT.

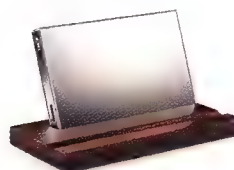
EXPECTED RELEASE: OUT NOW (US)

PRICE: US\$1,200

Whatever your opinion of curved screens, it's a trend that looks to be here to stay, with more electronic giants announcing products that exhibit the ever-so-slight bend. Samsung's had curved TVs for over a year now, and this new monitor brings that curve to PC gamers. The S34E790C consists of a 34-inch screen at 3,440 x 1,440-pixels with a 3000R curvature — providing a 178° viewing angle. With this being a gaming screen, Samsung's built-in a 'game boost' function adjusts the colour and contrast depending on the scene — although whether that actually works is, of course, questionable — hopefully we'll be able to get our hands on one to test soon. Round the back there's a single DisplayPort, two HDMI ports and five USB 3.0 ports as well as built-in speakers. While curved screens have a little more appeal to us as monitors (where you sit much closer to the display), whether it's worth US\$1,200 is another question entirely.



Samsung is bringing 'the curve' to gamers now with its new monitor.



The LaCie Mirror lets you know if someone's sneaking up behind you.

billed as providing the ultimate interactive experience when viewing 3D content. The display consists of a number of sensors which track head movement — adjusting the image based on your movement — and is able to output 1080p to each eye, while the stylus provides the interaction element by emitting a laser that's picked up by the screen. During the convention, HP demoed the product by allowing participants to interact with a 3D human heart, with users able to move in and around the object in complete 3D.

LACIE MIRROR

SHINY PRETTY THING.

EXPECTED RELEASE: LATE JANUARY

PRICE: US\$280

LaCie's well known for its alternately sleek and tough external storage devices and this new model wants to have a foot in both camps: it's covered in a scratch-resistant, mirror-like Gorilla Glass. The 1TB drive is above all eye-pleasing; it includes a stand made of ebony, suggesting the drive's purpose to store backups being only secondary to its ability to act as a fashion statement. Created in collaboration with French designer

HP ZVR

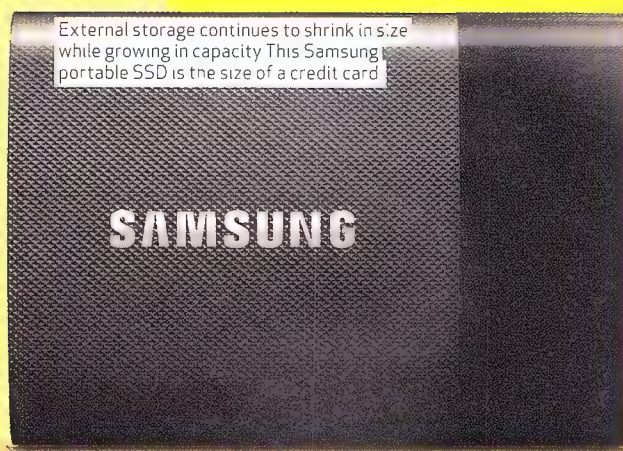
VR TO MAKE YOU SMARTER.

EXPECTED RELEASE: SPRING (US)

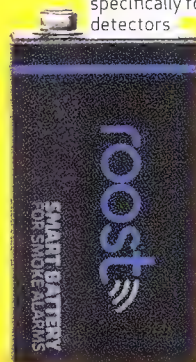
PRICE: TBC

While more of a concept device than a final product, HP has unveiled what it believes will be the educational tool of the future. Consisting of a 3D screen, wired stylus and glasses, the Zvr is

Pauline Deltour, the Mirror adds to LaCie's growing list of fashion-conscious PC peripherals. Of course, a glossy mirrored finish means this one'll likely attract some fingerprints — even with the Gorilla Glass — but hey, some people might be willing to make that sacrifice just to have easy access to their reflection.



External storage continues to shrink in size while growing in capacity. This Samsung portable SSD is the size of a credit card.



The Roost is a smart battery designed specifically for smoke detectors.



Boost the meagre storage on your smartphone with the iStick.

GEAR & GADGETS

SONY WALKMAN NW-ZX2

IT'S BACK... AGAIN.

EXPECTED RELEASE: AUTUMN 2015 (US)
PRICE: US\$1,200

The cassette tapes that birthed Sony's portable audio brand may have long since gone out of vogue, but that hasn't stopped the Japanese electronics company from reinventing the Walkman time and again. This latest is a high-resolution audio device that promises crystal-clear sound. This US\$1,200 device features support for a range of lossless file formats including DSD, AIFF and FLAC. What's more, running Android 4.2 the NW-ZX2 allows you to download and play apps via the touchscreen display. The device also includes support for Bluetooth and NFC pairing to easily stream music wirelessly – albeit with the possibility of audio not being quite so high-res. While 128GB of included storage may seem like a lot, high-quality audio files can be quite large, meaning that, depending on the size of your music library, you may need to make use of the built-in MicroSD slot to further bulk up the storage. Another important factor to consider – on top of the extreme cost – is that in order get the most out of this new Walkman you'll need to obtain high-quality sound files too. You won't find them on Spotify...

ISTICK PRO

MORE SPACE FOR YOUR SELFIES.

EXPECTED RELEASE: MARCH (US)
PRICE: TBC

Despite all the technological changes that smartphones and tablets have brought, one area we continue to struggle with is storage size – and our penchant for higher-quality cameras, high-def movies and graphic-intensive games all demand more space. Rather than require users to delete their

precious selfie collections they have stored on their phone, the iStick Pro provides additional storage in the form of a USB drive. Featuring a Lightning connector, the iStick Pro allows users to store and transfer files between Apple iOS devices and PC or Mac, with the transfer handled through an included app. On the other side of the device is a typical USB connector which can also be converted to become a MicroUSB connector – meaning the iStick is also compatible with Android devices. Coming in at sizes ranging from 16GB to 128GB, this one could help you clear enough space for one or two more selfies.

SAMSUNG PORTABLE SSD T1

SUPER SMALL STORAGE.

EXPECTED RELEASE: TBA
PRICE: US\$180 (250GB), US\$300 (500GB), US\$600 (1TB)

The T1 demonstrates just how compact storage devices have become; it's a 1TB solid state drive that's the size of a credit card. Promising transfer rates up to 450MB/s over USB 3.0, it's only 9.2mm thick. The one catch here is the cost – 'small, light and fast' means a premium price tag, with Samsung using a new technology it calls V-NAND flash memory to create a form of 3D-stacked storage, the key to getting such a large amount of storage in

such a small space. There's no Australian pricing yet, but a 1TB drive'll set you back US\$600, while the entry-level 250GB is around US\$180.

ROOST SMART BATTERY

A SMARTER BATTERY JUST FOR SMOKE ALARMS.

EXPECTED RELEASE: JUNE (US)
PRICE: US\$40

While the trusty 9-volt battery has yet to see any major technological advances, small company Roost is attempting to change all that. Beginning as a Kickstarter project, the company's new 9v is what they're calling a smart battery – although it's designed to be used with your ordinary smoke alarm. What makes this battery unique is its ability to connect to your Wi-Fi network and provide notifications to your smartphone – such as when the alarm detects smoke or when the battery (said to last up to five years) is running low, so you can swap it out in advance and avoid those annoying middle-of-the-night bleeps. Once the battery does eventually run out, the actual power cell can be replaced for a measly US\$10, giving you another five years of hassle-free protection.



Sony's new Walkman is aimed at giving you crystal-clear sound, so long as you load it with high quality audio.

technotes

» EPINIONS



Aomei Backupper is just one option you can use when cloning a drive.

BUDGET BACKUP

Here is a secure and cheap backup/cloning method I have used. The biggest problem when C: drive fails is reinstalling Windows and all of your other programs. How do you remember every piece of installed software? To counter this I did the following.

My system consisted of C: drive with Windows and program files and D: drive with data files.

I installed a 1TB third drive at a cost of \$65. Then using Aomei Backupper I cloned C: drive to the new E: drive. I ran Winmerge to check the source and destination were the same.

Then to test if Windows would boot from E: drive I disconnected the SATA cables from C: and D: drives. Then I booted up. All worked fine.

Now if C: drive fails I can just swap it with E: drive and continue working. Complete security for \$65.

Grant Wilson

FETCH

In your October edition PC Builder guide, you recommend turning off Prefetch and Superfetch to reduce thrashing of an SSD.

What about if you have a multi-disk system. My laptop has a 250GB SSD for Windows, etc, and a 1TB mechanical HDD for data, etc.

I gather the fetch setting is system-

wide, so would affect both drives? What is the trade-off in this case? Rick

Ed replies: You should be fine to leave fetching off in this kind of drive configuration, as it pretty much only affects Windows. However, if you were using a standard hard drive for your OS and say, an SSD as a secondary drive for a games collection, we'd recommend leaving prefetch and Superfetch turned on.

CHEWING THROUGH DOWNLOADS

I have had a problem with broadband usage and I'm not sure if I have resolved it. After clicking on a downloaded file that appeared to do "nothing", my internet usage rocketed overnight and within 2 or 3 days I had used up my 10GB usage.

Switching to my phone in desperation, I also used up 3GB on that while trying to research Trojans or viruses that caused this usage.

In total my usage in 5 days was well over 15GB resulting in excess usage charges. I have used Malware bytes and uncovered one Trojan and a heap of PUP's. Is this all I should expect or should I do more?

Brian Cosgrove

Ed replies: Malwarebytes should hopefully have cleared up the problem, but we'd

recommend installing a good security suite — even its it's just a free one, such as those from AVG (free.avg.com) or Avast (www.avast.com) — as these will provide better real-time protection from threats.

SAFETY FIRST

I read with interest your December issue's article on privacy and security. I currently use McAfee on my laptop and Norton on my PC so I was pleased to see that these products rate highly in your article.

I use Norton 360 rather than the Norton Internet Security 2014 included in your review. Do you think that 360 has the same capabilities as the Norton product you reviewed?

Both the McAfee and Norton packages are up for renewal in this month and I will be looking at BitDefender Internet Security as a possible alternative.

Thanks for an interesting magazine. Peter Elliott

Ed replies: It's our understanding that both of these Norton products use the same scanning engine, 360 just includes a broader suite of extras. However, Norton 360 has actually been discontinued from sale in the US, where its been replaced by 'Norton Security with Backup', so we'd expect the same thing to occur in Australia soon. ■



Antivirus suites are must-have programs to protect both your PC from viruses and your personal information from identity thieves.

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Australian TV & movie streaming finally a reality

Despite the arrival of big-name streaming video services to Australia, the future of TV-watching down under is anything but clear. Joel Burgess

Sling TV was crowned with one of the official 'Best of CES' awards this year – it's a newly-announced, standalone web-TV service that includes channels like ESPN and CNN. Due to be released this year in the US, the service is just one of many internet-based TV alternatives that could mark the demise of cable TV – in the US, at least. Both HBO and Showtime have plans to launch their own on-demand streaming services this year, with the hope for both companies being that these cheaper, internet-based alternatives can bring in more customers by offering a more personal TV selection at a lower price tag.

In Australia we are a bit behind when it comes to web streaming video, but the imminent arrival of Netflix and the launch of local competitor Stan (backed by Nine Entertainment and Fairfax Media's StreamCo.) certainly indicates that the Australian pay TV landscape is ready to take its first big steps into streaming. Spurred by the arrival of new competition, Foxtel and Seven West Media are planning to add TV to their Presto movie service, and the longer-established Quickflix (its \$9.99 subscription streaming service launched in April last year) announced the addition of a pay-per-view premium catalogue that will allow users to complement their subscription shows with the latest release titles.

With four major players all fighting for a share of what is fundamentally a

new product in Australia, there's no doubt that the introduction of streaming will disrupt the way we watch television. But is streaming itself enough to end the dominance of Australian cable-TV providers like Foxtel, FetchTV and Telstra's T-Box?

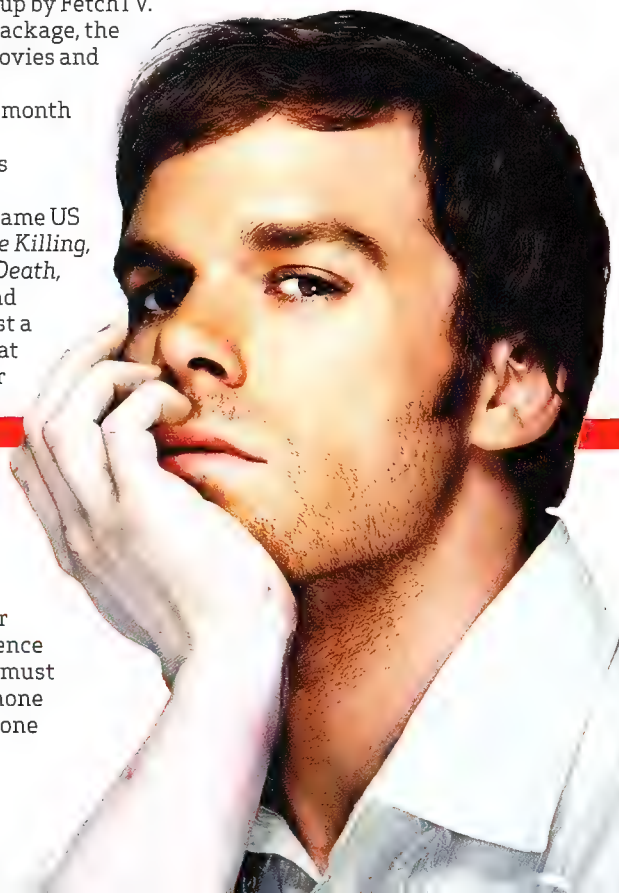
On basic cable TV contracts, such as Foxtel's entry-level \$25 per month service, there isn't a huge overlap between web-streaming and cable content. Similarly, Australia's second-largest pay-TV provider, FetchTV, recently acquired three BBC channels, and although Stan announced deals for a number of BBC programs, the only obvious overlap is on the program *TopGear*. Quickflix currently has a number of BBC programs on its streaming service too, including *Sherlock*, *Little Britain*, *Faulty Towers*, *The Office* and *Torchwood*, but these programs are not shown on the BBC's First, Knowledge or UKTV channels – those which were picked up by FetchTV.

Foxtel's more intense package, the entertainment, sports, movies and drama combo, which sets subscribers back \$90 per month – \$40 more than the entertainment and sports package – will not be as unaffected though. Big-name US shows like *Entourage*, *The Killing*, *The West Wing*, *Bored to Death*, *Dexter*, *The Newsroom* and *Boardwalk Empire* are just a few examples of those that will be available on one or

other of the streaming services, most of which seem to be settling for a \$10 per month price, with no lock in contracts.

When you also consider the extensive deals for movie titles by streaming players, the arrival of this new competition could definitely be game-changing for Foxtel's premium tiers of service.

Foxtel already has a comparatively tough time in the Australian market, sharing a 30% cable TV penetration rate with FetchTV – much lower than in the UK or US. Stringent 'anti-siphoning' laws also limit pay TV's ability to offer exclusive sports content by giving free-to-air channels first dibs on big matches. The arrival of streaming may not eliminate cable TV, but it'll certainly put pay providers like Foxtel in a tighter spot – one where they're firmly wedged between the web-based newcomers and their traditional free-to-air competitors. ■



ENDUSER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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Aorus X7 Pro

Why opt for just one GPU in your laptop when you can have two?

The X7 Pro is, to put it mildly, a bit of a beast. This 17.3-inch machine is from Gigabyte's spin off brand, Aorus, which is dedicated to gaming-oriented products. We've reviewed a handful of Aorus peripherals, but this is the first laptop we've seen. And when it comes to performance, it's a ripper, with top-level specs in almost every area. There's a speedy quad-core Core i7-4870HQ processor combined with 16GB of memory and a RAIDed SSD setup using two 256GB mSATA Liteon drives – the quickest storage array we've ever tested in a laptop (or desktop, for that matter) with not just fast sustained transfer speeds, but very quick random access times.

The real stand out is the dual-GPU graphics. Nvidia's laptop-friendly GeForce GTX 970M GPU only landed a couple of months back, but Aorus has already managed to sandwich two of them into the X7 Pro's comparatively-thin chassis. Comparing this X7 Pro to the Venom

Blackbook 15 that we tested last month (with a single 970M) shows that running two of these chips in SLI doesn't double performance. It does give you an extra 50-60% boost in frame rates, however – or around what you see in desktop SLI set ups. This is a laptop that can keep many games running above 200fps at its native 1080p resolution with Medium details – and often above 100fps at full tilt. For gaming on the go, you'll find nothing faster.

And while there's no mistaking that the X7 Pro is a big laptop – the 17.3-inch screen guarantees a large footprint – it's not a behemoth, weighing in at 3kg and, when closed, its profile is just 23mm. That sizeable footprint delivers some advantages too, like a near full-size keyboard with numpad (including a bank of macro keys), combined with an equally-large trackpad.

However, while it's hard to say the X7 Pro is missing anything, there are some areas that don't impress as much as its performance.

The charger is quite large and adds another kilo to the carry weight – and if you are heading out on the road with, you'll want to keep that charger with you, battery life only runs to around 2 hours in 'office task' usage.

The trackpad, too, can be frustrating at times. Its gloss finish means it can get a bit tacky in humid conditions.

The 1080p LCD screen is likewise good but not great. The colours are fairly rich and natural, but the viewing angles for dark colours can be quite narrow, meaning playing shadowy games like *Alien: Isolation* requires a pitch-black room and the screen angled perfectly.

In our minds though, the biggest flaw is how noisy the cooling system is. Two GPUs and a super-fast processor generate a lot of heat, and in a thin laptop like this one that means you need powerful fans to vent it. In desktop use, like web surfing or even watching movies, the X7 Pro is fairly sedate, noise wise. But throw a game on and its fans immediately ramp up to high speed, with a

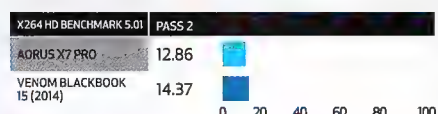
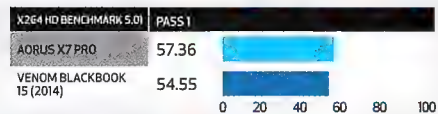
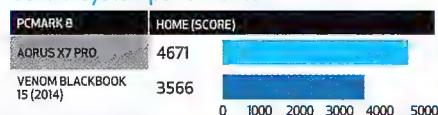
whooshing sound loud enough that we had to raise our voice to speak over it. And even dropping game resolutions to 720p and details down to Medium didn't do anything to dampen those fans' enthusiasm – when you're gaming, they pretty much run full tilt, all the time.

On the plus side, that cooling system keeps the GPUs comfortable – they averaged around 73°C.

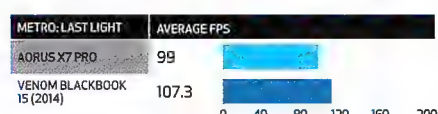
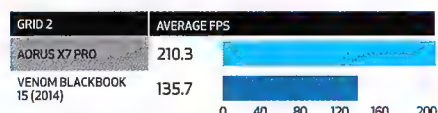
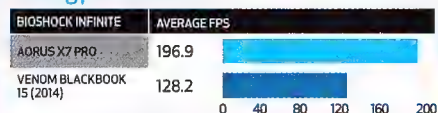
While the X7 Pro doesn't disappoint in terms of hardware or value, those design niggles do add up – and that noise level in particular does undermine the elegance of this machine as a whole. ■ Dan Gardiner

LABS BENCHMARK RESULTS

General system performance



Gaming performance*



* ALL GAMES TESTED AT 1080P/MEDIUM DETAILS.

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

It's big, fast and surprisingly slim, but that elegance unfortunately doesn't extend to every area.





ADSL ROUTER

#329 | WWW.DLINK.COM.AU

D-Link Viper DSL-2900AL

Once bitten... twice as fast?

Despite the slick new 'Viper' moniker, D-Link's latest wireless ADSL 2+ router is essentially just an update of the company's ageing DSL-2890AL. The latter's still a reasonably competitive little device when it comes to speed but the device's user interface is, to put it kindly, a little dated. (To be less kind, it looks like it could have come from any D-Link router, circa 2005.)

While the chassis of this new model is almost identical to its forbear – a cylindrical tower with a big bank of status lights on the front, plus USB 2.0 and 3.0 ports in the back alongside four Gigabit Ethernet sockets and an ADSL line-in – the UI has thankfully been considerably spruced and is now more modern, informative and easier to navigate.

So what's with that 'Viper' name? We suspect that it's D-Link's attempt to cash in on some of the success Netgear has had with its recent Nighthawk routers,

which are higher-end products deliberately pitched at networking enthusiasts.

In terms of Wi-Fi specs, the Viper certainly has the parts to compete – it's packing dedicated 1,300Mbps 802.11ac 5GHz and 600Mbps 802.11n 2.4GHz radios and, in testing, it was no slouch, with very speedy read/write transfer rates of 59.3 and 61.9MB/s (respectively) at close range. That's close to the fastest we've seen from an 802.11ac router. Unfortunately, that speed didn't hold up quite so well at longer distances. While read speeds remained very competitive (37MB/s – again, one of the fastest we've tested) write speeds dropped off significantly, down to 12.9MB/s. Most other recent models, including the D-Link's own DSL-2890AL, manage 20-30MB/s.

The other problem for the Viper is that there aren't actually a lot of enthusiast-level features here. It runs pretty much the same software OS as D-Link's

"It was no slouch, with very speedy read/write transfer rates of 59.3 and 61.9MB/s at close range."

other current routers, with no extra advanced options. And that OS is, frankly, a little hit and miss. We like the clean main status page alongside the ability to dig into the advanced settings to see network traffic in real time. The router automatically checks for firmware upgrades and applying them is just a matter of a few clicks. The quality-of-service features, too, are very easy to use – just drag and drop devices into the three different categories to control who gets priority – but they're also a little basic.

Likewise, the parental controls are pretty rudimentary – you can manually enter up to 15 sites to blacklist, but that's about it. Unlike Belkin or

Netgear's recent routers, there's no ability to use a cloud-based site blacklist service to automatically filter sites based on configurable criteria.

In sum, considering the Viper's premium price and branding, we'd be expecting more genuine enthusiast-level features – and flawless wireless performance.

■ Dan Gardiner

Verdict

Features	★★★★☆
Performance	★★★★★
Value	★★★★☆

It's fast, but the features don't quite live up to the premium name. Or price.





MONITOR

\$1,049 | WWW.PHILIPS.COM.AU

Philips BDM4065UC

Is this the screen we've been searching for?

Even before this screen arrived at APC, we had a notion that when it came to 4K monitors, the TV market was going to be particularly relevant. HDTVs have always offered better value for money than monitors as they're cranked out in mega volumes. The problem is, until recently, they've all been 1080p at best. Once you get beyond 24 inches, that means pretty big pixels. Step that up to 40-inches or more and things get really ugly. HDTVs, then, have made pretty poor monitors.

Meanwhile, the first budget 4K monitors have appeared, but offered just 28-inches, diagonally and that means the dot pitch is tiny – which causes all kinds of problems in Windows. Leave the scaling at 100% and everything is squintingly small, but tweak the Windows and browser scaling settings and everything looks hideous.

But what if you had a 4K PC monitor that was 40-inches in diagonal? Then you'd have a monitor on an epic scale with a pixel pitch in that workable window where it's fine enough to enable a crisp, sharp image, but not so fine you have the scaling dilemma. And guess what, 40-inches is bang into budget HDTV territory in terms of panels and production volumes. That explains why this, 40-inch, 4K Philips is cheaper than existing 30-inch 2,560 x 1,600 pixel monitors.

Hold on though, you can't just take a 4K HDTV off the shelf and use it as a PC monitor. That's because the bandwidth limitations of the HDMI restrict it to 30fps. What you need is the latest DisplayPort 1.2 interface, and you don't get that with TVs. Instead, Philips has taken one of its budget 4K HDTV models, ripped out the TV tuner, and dropped in DisplayPort 1.2 to allow a 60Hz refresh from a single transport stream. No frills

– just the minimum you need from a PC monitor.

That's great news. The main upsides are the affordability – OK, \$1,050 is still a lot of money, but spread that over five, six, seven or more years and the annual cost looks reasonable. Then there's the slimline shape of the chassis and the super-skinny bezel in traditional HDTV style.

However, it's not all good news. The most obvious downside is a stand that doesn't adjust. At all.

But, the real problem is with the panel itself. In some ways it's a glorious thing on a wondrous scale. Actually, it could be too much of a good thing, with the 4K pixel grid exposing any low-res textures with ruthless efficiency. Oh, and if you're wondering, the semi-gloss panel surface works well; reflectivity is limited.

Where the HDTV negative kicks in is with the vertical alignment (VA), rather than IPS panel tech. It delivers lovely deep blacks and nice,

rich colours, but also serves up viewing angles that are basically a bit broken. The problem is most obvious at the extremities of the display, especially along the bottom. If you sit back far enough, the issue resolves – but this is a PC monitor and you want to sit close.

Moreover, even multi-GPU PC setups will struggle to run games at 4K on Ultra.

Plenty to think about, then, and this is at least a tantalising glimpse of the 40-inch 4K form factor that could be the weapon of choice for high-end gaming for the foreseeable future.

■ Jeremy Laird

Verdict

Features
Performance
Value



Lovely HDTV-style chassis and cheaper than most 30-inchers, but no adjustable stand and still quite expensive.





4K Graphics

4th gen Intel® Core™ processors,
discrete NVIDIA® GeForce® GPU

Dual Bay

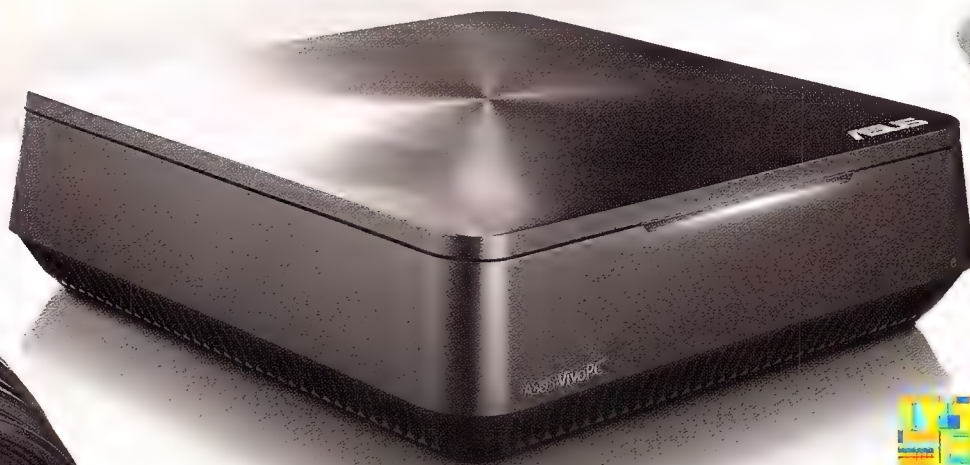
Accommodate up to two
storage drives for added flexibility

ASUS Cloud

ASUS HomeCloud software for easy file
storage, sharing and streaming

Perfect Audio

Integrated SonicMaster speakers for
premium sound



VM62 Series

ASUS VivoPC
Chic yet powerful mini PC



Intel® Core™ i5 processor

Where to buy: www.asuspromotion.net/au/wheretobuy/vivo.htm



MONITOR

\$215 | VIEWSONIC.COM.AU

ViewSonic VX2363Smhl

Is this budget IPS really that budget?

Here in the APC labs, we're always a little giddy over the huge range of different monitors we set up in the office. From super-wide to super hi-res to super-quick, we see the lot. Well, if you were prepared to spend a fair chunk of cash anyway. What we don't always see though, are many budget-oriented screens, just high-spec panels.

What do you do if you don't have the cash to spend on a massive panel? Thankfully ViewSonic has been creating good-value monitors, with our favourite panel technology inside, for years. We've been recommending the 23-inch VX2370Smh as our pick of the budget screens for a long while now, but such things don't last forever and that monitor is now getting harder and harder to find. Thankfully it's getting replaced by this slightly smaller, but still happily IPS-laden, VX2363Smhl.

This vision in white plastic is reminiscent of some of the budget AOC IPS screens we've seen in the past, using a recessed bezel to make it seem like the panel stretches out to the very edge of the monitor's face. That gives the screen a nicely classy look on your desktop and the actual panel doesn't disappoint either.

At this price you'd maybe expect to have TN tech forced upon you, but even these 6-bit IPS panels have much better visuals than an old budget TN screen. The viewing angles aren't up there with the finest panels we've seen recently, but the colours are still vibrant and the contrast levels are good, as well. The black levels and white saturation of this screen, even straight out of the box, are also really impressive.

NOT SO PRO

We're not going to pretend this panel is totally perfect, or will work for photo

professionals, but for a seriously budget IPS screen the VX2363Smhl is really impressive for the money. The surrounds, however, are a little less impressive. The stand is a very basic tilt affair, while the sheer mass of plastic on show speaks to its budget heritage, too. But when you're plugging *Far Cry 4*'s endangered species in glorious Technicolor, you're not going to give a pair of fetid Sky Tiger kidneys what's surrounding your screen. All you want are the visuals being piped directly into your eyeballs with decent panel tech.

We would also argue there's little point in spending more money on a 1080p panel. If you're going to be splashing any more cash we'd recommend pointing it at a larger, higher-resolution monitor. The way things are going you're likely to want to upgrade to a higher resolution monitor fairly soon anyway – hardware performance has nailed

1080p even in the lower echelons of GPU tech, so we're moving forwards to 1440p and 4K next.

Spending \$215 on this screen will keep you happy with your current rig, offering pleasing IPS visuals without shredding your wallet. It should also keep you going until your next hardware upgrade, at which point you may well be looking to pick up a better screen to show off your nice new hardware, too.

■ Dave James

Verdict

Features
Performance
Value



IPS panel, great price, invisibezel, a Plasticky chassis.





MOTHERBOARD

\$229 | WWW.ASUS.COM/AU

ASUS Z97 Sabertooth Mark S

A super-special Z97 primed for Winter warfare.

So, you want to stand out from the crowd and build an all-white PC? Well let's see how far you can get. Case, no problem. PSU? Check. There's a few of those around as well. Graphics card? Tick. Harder to find but there are one or two available. White motherboard? Well, that's much more of a problem. White motherboards are like the Holy Grail of the modding world. In fact, giving it some serious thought, we can only think of two board manufacturers that ever ventured into the expensive world of producing white PCBs: Sapphire and Soyo. Hold on, ancient Abit made one too, so that's three. And mentioning those last two long-forgotten names will give you an idea of how long ago it was.

All is not lost however because ASUS has a limited edition white version of its Z97 Sabertooth board. The Sabertooth Mark S is an absolute stunner, too. It may

seem a little shallow to get excited about how a motherboard looks, but it must be said that even this cynical old hack cracked a smile and must tip his hat in approval at just how classy the Mark S looks. It isn't a total sea of white, however, as the TUF Sabertooth 'thermal armour' sports a natty white and grey camo scheme, beloved of Arctic-based Special Forces teams and *Battlefield 4* players.

It's up to you to decide whether this enhances the white PCB or makes you wish ASUS had gone the whole hog and made everything just plain white, we're still not sure. Even the reinforced back plate, or TUF Fortifier technology as ASUS calls it, gets the camo treatment. But, why ASUS, do you go and compromise the scheme by adding a couple of green and beige ports when every other port and slot is black?

Hardware-wise the board follows the lead of the Sabertooth Mark I; two PCIe 3.0 x16 slots running at x16 with a single graphics card,

or x8/x8 when two cards are used. Connectivity extends to a single PCIe 2.0 x4 slot which sits near the bottom of the board and another three PCIe x1 slots. Six edge-mounted SATA 6Gbps ports are supported by the chipset along with a SATA Express port. A further two SATA 6Gbps ports placed towards the base of the board are looked after by an ASMedia controller. One thing notable by its absence is the chipset-supported M.2 slot. But pull off the 'thermal armour' and it becomes plain why – there's simply no room.

ASUS' TUF range is all about cooling flexibility and thermal monitoring, and one look at the Thermal Radar 2 in the ASUS software AI Suite shows it isn't mucking around. It's probably the most comprehensive thermal management package available, with no less than 13 pages of settings that enable you to tinker with just about everything on the board, cooling wise.

A quick word about the dust prevention package

ASUS has included; that word is comprehensive. If it's a port and it's not being used, there's a rubber bung for it, but keeping with the overall scheme, the covers for the spare PCIe and memory slots are coloured white.

The problem is that the special edition premium adds a special premium amount onto the price tag. That wouldn't be an issue if there was the sort of feature set you get with the expensive RoG boards, or the same benchmark levels. Unfortunately the whitewash aesthetic is what you're paying for here, not some beefed-up PC performance. ■ Simon Crisp

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Looks cool, great thermal management and dust prevention; but too expensive, with no chipset-supported M.2 slot.





INTEL MOTHERBOARD

\$189 | AU.MSI.COM

MSI Z97 Gaming 5

A good performer for the price.

MSI vs ASUS. Motherboard on motherboard action. A \$189 deathmatch. On paper, this MSI Z97 Gaming 5 and the ASUS Z97-A couldn't be much more closely matched. So is it a battle of pure attrition? Or are there enough differences to make a compelling argument for each of them?

Dig a little deeper and the MSI certainly carves out a bit of a niche for itself. With the unambiguous 'Gaming' branding comes a bit more effort on the aesthetics. Beyond the de rigueur red-and-black colour scheme (these colours must trip some kind of Pavlovian response in gamers), there is also an alluring matte finish to the PCB.

It's a superficial feature. The PCB itself is not as thick as a true high-end board, nor does it sport as many electrical layers. But the matte finish still manages to make ASUS' Z97-A feel a little bit skanky. A small

victory for MSI, then.

Arguably of more importance are the actual gamer-centric features of this board. These start with a clear CMOS switch, which is helpful should you dial in some ill-advised BIOS settings that prevent the machine from booting. Next up are voltage monitoring ports (admittedly, a fringe attraction), five four-pin fan power ports and an LED debug display.

True to its gaming remit, this motherboard also gives you support for both SLI and CrossfireX multi-GPU graphics solutions. Overall, then, the feel is less generic and more enthusiast-focused than the ASUS Z97-A. However, that's not quite to say the Gaming 5 has things all its own way.

Our review sample had a bit of a hard life and was consequently behaving a little oddly. It was slow to boot and recalcitrant to recognise devices, that sort of thing. That may explain its relatively poor showing

in the stock-clocked benchmarks, where it pretty much trailed in last across the board.

Slightly against expectations, given its sickly demeanour, it clocked up a perfectly healthy 4.6GHz in our overclocking test and the second fastest overclocked Cinebench score, even edging the ASRock Z97 Extreme4 running at 4.7GHz. As our American cousins would say, go figure.

You'll be missing out on one or two core features compared to the ASUS board, too.

For starters, SATA Express doesn't make an appearance. The PCI Express storage support is limited to M.2. M.2 is our pick of the two interfaces and the one that we'd expect to use for our main boot drive. SATA Express is more of a bridging technology to smooth the transition from SATA to PCI Express. But we'd still prefer to have both.

The other obvious omission is DisplayPort output for integrated graphics. Again, hardly a deal-breaker on a gaming board that's surely going to be hooked up with a proper graphics card.

Overall, MSI's Z97 Gaming 5 makes a very good case for itself. If our sample hadn't been a bit borked, it would have taken the fight right down to the wire with the ASUS Z97-A. It might even have won. As it is, the benefit of the doubt must go to the ASUS motherboard instead.

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★★★★

This board looked promising and is a good price. However, sample issues were a problem in testing.





CORE X SERIES

YOUR BUILD. OUR CORE.

PERFORMANCE UNLEASHED

The Core X Series by Thermaltake is a cube based chassis. Years of testing and research have allowed our engineers and designers to craft the ultimate line that's dedicated to enthusiast performance and high-end liquid cooling. The Core X Series delivers outstanding cooling performance and unrivalled compatibility for extensive DIY/AIO LCS and overclocking components.



“ THERMALTAKE
BLOWS OUR MIND WITH
ONE OF THE BEST CHASSIS
OFFERINGS EVER ”
-TWEAKTOWN

ENDLESSLY STACKABLE

With its endless stacking design, the Core X Series is in a class above the rest. Virtually limitless utility is possible; the chassis offers an expandable system allowing enthusiasts to incorporate externally-modular upgrades. Stacked together, the chassis opens up space to expand the liquid cooling system, storage solutions, or even create dual systems - seamlessly enabling a dedicated top/bottom set-up for unmatched cooling. It doesn't get any better than this.



LIQUID COOLING FOR ENTHUSIASTS

Tt LCS Certified is a Thermaltake exclusive certification applied to only a select range of products that pass our own strict design and hardcore enthusiasts standards that a true LCS chassis is held to. The Core X Series is designed to handle even the most extreme PC cooling thanks to a unique fully modular chamber concept; allowing you to build exactly the way you want to.

CORE X1
SUPPORTS MINI-ITX

CORE X2
UP TO MICRO-ATX

CORE X9
UP TO E-ATX



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PC CASE

\$125 | WWW.CORSAIR.COM

Corsair Carbide Air 240

A chassis you can't help but want to build in.

The Carbide Air 240 is basically a 'Honey, I shrunk the Air 540' case, being an almost exact copy of that cuboid chassis, which we couldn't help but love. Its neat design hid away the power tentacles of your PSU and your drives in one area, while leaving the sexy bits on display in the opposite side with a huge Perspex panel to show them off.

And Corsair has simply taken that design and scaled it down to fit the mini-ITX form factor here. Well, actually we're sure it was anything but simple, because Corsair has had to re-engineer and rejig the internals to cope with less space but essentially the same size components. Somehow though it has managed to create a mini-ITX case that feels small but roomy. Pulling it apart and looking inside we couldn't help but immediately want to start building a PC in it. It's impressively well-designed,

with easy access to both 2.5 and separate 3.5-inch drive bays (three of each) and there's a wealth of space inside for either a relatively tall tower cooler or a chunky 240mm water cooler attached to the front vent. The Carbide Air 240 has retained that large expanse of Perspex on the side panel too, which means your gaming components can get the display case they deserve. The motherboard is the only thing you really need to make sure is mini-ITX compatible. It's not the smallest mini-ITX chassis, though that's the only vague negative we can find. Which all means the Corsair Carbide Air 240 is small, but pretty much perfectly formed.

■ Dave James

Verdict

Compact; smart design; ample space; a little chunky.



PC CASE

\$189 | WWW.XFXFORCE.COM

XFX Type-01 Bravo Edition

A veteran of the graphics card and PSU markets ventures into cases.

XFX certainly hasn't just opted for an off-the-shelf look with its first ever PC case. That's not only to do with its unique looks, but also because of just how big it is.

Although the external skin of the case is mostly ABS and Acrylic black-finished plastic, it has a 0.7mm steel frame (also finished in black) which is the reason why it weighs a respectable 10.5kg. The case has plastic looped surrounds on the top, at the front and the back which support the case and, because they raise it off the floor, they also allow air in through the filtered bottom vent. And when it comes to active cooling the Bravo is quite well-served. Lurking behind the front bezel is a 200mm fan while a 140mm exhaust fan sits at the top of the rear panel. As for water cooling support, well the easiest thing would be to mount an external radiator; not ideal, in other words. There are three 5.25in drive bays with

tool-free mounts, while the two internal drive cages can support up to eight drives. That all sounds pretty straightforward but it's actually a bit more clever than that. The bottom cage holds up to three 3.5/2.5in drives and the top cage can support up to five drives. The crafty bit is that this top cage has a movable side support, so if you're only going to fit 2.5in drives in it you can make the cage narrower to allow for longer graphics cards to be used. As a first foray into the world of case-building, the Bravo's a good first try, but we're still disappointed about the lack of support for larger closed-loop water-cooling sets — that seems a bit of an oversight for a gaming case.

■ Simon Crisp

Verdict

Good value for money; nice-looking while still functional; adaptable drive cage.





Rapoo V700

A basic mechanical keyboard that does exactly what it's s'pos'da.

Low on frills but with very solid performance, the Rapoo V700 is a mechanical keyboard for those who just want the basics... and not a whole lot more.

Using the company's own yellow switches under each key, typing on this board is smooth and linear. The switches don't have a tactile 'hump' (so you can't feel exactly where in a stroke they've been activated) and are about half way between red and black switches in terms of resistance. It's a comfortable level that doesn't require much pressure, but which is strong enough that you can rest your fingers on the keys without worry that you'll accidentally press one. It's also incredibly sturdy and rigid thanks to an orange-coloured metal plate in the middle, into which the switches are mounted. Rapoo's yellow switches are quite quiet in use, although the V700 isn't silent; strike keys with force and you'll

hear a low 'tong' sound from the metal plate underneath, reverberating slightly with each stroke. It's definitely audible, but far less annoying than the clacking of a blue-switched mechanical board. While there's no USB hub or key backlighting, you do get a tougher, braided USB cord. And there is one special feature: a dedicated gaming mode. It's activated by hitting a special M key at top right, and lets you set up macros on basically any keyboard key for use in game. When you're done gaming, just hit that M key again to switch back to normal operation. All up, this is a well-built and good performing mechanical board for a keen price.

■ Dan Gardiner

Verdict

Not overflowing with features, but the performance is good and the price is nice.



Aorus Thunder K7

Is it a Transformer? A mechanical gaming keyboard? It's both!

More a technical gaming kit than a standard keyboard, the Thunder K7 has three parts – a pint-sized 'tenkeyless' gaming keyboard, a numpad, and a wrist rest.

You can attach the latter two as preferred to go from a tiny space-saving board to a gargantuan, desk-sprawling monster. It all snaps together relatively seamlessly with magnets and the numpad can live on the left or right. The idea behind the transforming design is the numpad also doubles as a bank of macro keys – so attaching it to the left, you could have a huge array of preprogrammed actions ready for your MMO shenanigans. Aorus's macro-creation app is full featured too, with six profiles so you can easily switch between different macro sets for different games. The physical key action is likewise very sturdy, though you've only got the choice of Cherry Red – that's the softest linear

offering and isn't to everyone's taste, although it is at least quiet. The K7 has a couple of drawbacks though. The backlighting prioritises illuminating its macro designation number (ie. G1, G2, G3 and so on) over its numpad (1, 2, 3, Del, Numlock) which means you sometimes need to squint a bit to identify the latter. The K7's fold-out feet, which prop up the back of the board, could be a little more rigid – they have a tendency to fold down if you push the board too hard. Those are both occasional rather than constant niggles, however, and otherwise this is a unique gaming board. If you can make use of its slightly odd feature set, we can definitely recommend it.

■ Dan Gardiner

Verdict

A left-of-field idea, but one that's mostly made good here.





GAMING HEADSET

\$89 | WWW.STEELSERIES.COM

SteelSeries Siberia RAW Prism

A headset as reliably colourful as the language you shout into it.

The major selling point of SteelSeries' new budget gaming headset is colour.

Prism is the name of the company's RGB LED colour customisation tech, used to change the hue of the rings around each earpiece. So, once you plug these cans in via USB and load some software you can obsess about the exact shade of varicose vein blue you want your head to emit. The downside of USB is the inability to connect the RAW Prism to your phone or plug it directly into a soundcard, so there's a real trade-off here in the name of colour.

That's about it for standout features on this minimalist headset, except for its discrete internal mic. There's just a barely noticeable nub on the left-hand side which is competent, though you'll need to boost your outgoing signal in Windows or the SteelSeries' software. They're very comfortable thanks to lightweight materials and generous

padding on both ears and the headband. We did see signs of wear and tear after just three weeks of use though, so don't expect bomb-proof construction. Naturally, sound quality overrides all the above considerations, and this is another area in which the RAW Prism walks the walk. It's a simple two-channel stereo offering with a nice wide spread, so you'll hear panned sound cues quite accurately. The cans do give away their pricing in their muddy bass reproduction, though. It's an overall success for these colourful cans thanks to affordable pricing and the absence of any real annoyances though. If you think in RGB, this could be your dream headset.

■ Phil Iwaniuk

Verdict

Unfussy and reliable cans that don't disappoint in terms of sound and comfort; colourful too.



GAMING HEADSET

\$149 | WWW.TURTLEBEACH.COM

Turtle Beach Ear Force Z60

Are 60mm drivers the new gold standard for gaming headsets?

If you've had the pleasure of trying out Kingston's superlative HyperX Cloud headset and heard its thunderous bass, you'd say its 53mm driver units were big enough to power any gaming audio kit. The industry, however, apparently disagrees, with Turtle Beach producing a 60mm pair with this Z60 surround headset.

Did we say surround sound? Sorry, we meant DTS Headphone: X, which is a "revolutionary" 360-degree, 3D sound tech that gives not just space but height to sound cues. If that sounds a bit far-fetched, well... it isn't. You really do hear the illusion of sounds coming from high above as well as behind or around you. Turtle Beach has made a name for itself on the console market by combining great surround sound with strong build quality, but it doesn't tend to release as many models for us PC users. It's really bringing its A game to our realm with this model,

though. The headset itself connects to an inline control which offers preset sound behaviours for gaming, music and movies (as well as the usual volume/mic controls). Movie mode boosts the speech frequency range to keep dialogue clear, while also pumping up the bass to keep the sound effects hard-hitting. Game mode goes even further with the bass, boosting low frequencies to a level you can feel as much as hear. Music mode is as close as the Z60 comes to placating the audiophiles, flattening out the frequency response. The headset design is adjustable, breathable and strong, if plasticky. Still, this is a good all-rounder, as you'd expect given Turtle Beach's previous cans. ■ Phil Iwaniuk

Verdict

Surround sound that's more than marketing bluster; very adjustable.





GAINWARD

NVIDIA
GEFORCE
GTX



PHANTOM GEFORCE GTX™ 960



15% up
PERFORMANCE UPGRADE

New Phantom cooler design

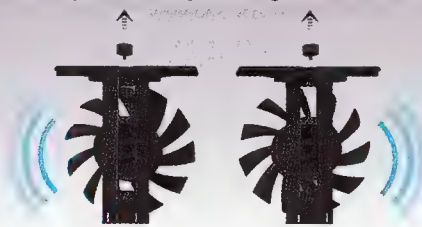
Gainward GTX 960 Phantom, continue the elegant design of the first generation. The new Phantom comes with brand new fans design

(Patent M456684/ZL201320139962.6) that includes

- 1) Removable fan design - each fan body can be removed to clean if necessary
- 2) 4 pieces of copper heat-pipe and copper base - better thermal performance
- 3) solid structure

With this new outstanding innovated thermal design and optimized product design Gainward GTX 960 Phantom delivers an extreme gaming performance for enthusiast gamers.

Removable, Easily clean dust by removing the fan from the cooler



2 Quiet and Removable Fans





SMARTPHONE

\$869 | PLAY.GOOGLE.COM/DEVICES

Google Nexus 6

A Google phablet that's sweetened by Android Lollipop.

The Nexus 6 was the first smartphone to run Android 5.0 Lollipop and there's no better way to experience all of the changes Google has made to its OS. It parades the new Material Design interface on a massive 6-inch display, moves seamlessly between apps thanks to the latest Snapdragon processor and 3GB of RAM, and lasts all day with a Qi-chargeable 3,220mAh battery.

The Nexus 6 has a head-turning 5.96-inch AMOLED display that's not only bigger and brighter than the Moto X, but edges out the 5.5-inch iPhone 6 Plus in every way. That's because it doubles down on Apple's full HD screen with a more stunning 2,560 x 1,440 resolution and 493 pixels per inch.

There are already members of the 'Quad HD' club, including Android members like the LG G3 and Samsung Galaxy Note 4, but Google Nexus 6 stands out from the pack with its exaggerated display.

There's no 6-inch juggernaut like it and its edge-to-edge display and on-screen soft buttons maximise the screen real estate while minimising the overall phone's dimensions.

The Google Nexus 6 also feels better in the hand for its size. Motorola's design, borrowed from the Moto X, gives it a sturdy aluminium metal frame and gently curved back. The curve feels natural against the hand – or, in most cases, hands – and the plastic back is at least smooth. The Nexus 6 colours are limited to either Cloud White or Midnight Blue, but it has the advantage of being compatible with Qi wireless chargers: a feature tricked-out Moto X phones don't support.

Google's new phone also benefits from dual speakers at the top and bottom and comes with a Turbo Charger that juices up the phone with six additional hours of battery in just 15 minutes.

At the heart of the Nexus 6 is a 2.7GHz Qualcomm Snapdragon 805 quad-core

processor that has an Adreno 420 GPU. It's a top-of-the-line chip for Google's largest Android phone yet. Backing that up is 3GB of RAM and a reasonable 32GB or 64GB of internal storage: no silly 16GB model here.

All of these Nexus 6 specs aren't overkill: they're important for the lightweight, but feature-filled, Android Lollipop update that's pre-installed on the phone. Android does more things than ever in the background: running multiple apps, receiving notifications that hit the new lockscreen non-stop, making the instantly accessible Google Now available with one swipe to the left, and performing voice searches whenever you say the infamous words, "OK Google". Around back, there's a 13-megapixel camera that seems to be on par with 13-megapixel Moto X snapper. It isn't. It has a better Sony IMX214 sensor with a wider f/2.0 aperture and optical image stabilisation.

The Nexus 6's US release date was 12 November and its pre-orders sold out immediately. The release date was very confusing and unclear until very recently. The Nexus 6 was meant to be available for preorder on Google Play during November, but that just hasn't happened. However, as we go to press, the Nexus 6 has popped up on Staticice for \$869: a fair price given the specs and internal storage, and that it's \$888 at JB Hi-Fi. This is also the same price as the 16GB model of the 4.7-inch iPhone 6, which is smaller in both physical design and storage size.

■ Matt Swider

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Its tremendous display, premium specs and debut of Android 5.0 make the Nexus 6 the best phablet to date.



software

» APPS FOR ALL THE PLATFORMS



Windows SOFTWARE

Adobe Premiere Elements 13

Mid-level video-editing just became even easier.

\$99.95 | ADOBE | WWW.ADOBE.COM/AU



When you're done with Windows Movie Maker, it's time for Premiere Elements. Adobe's fantastic (and friendly) editing tool packs more than enough power for any home project, as well as its guidance easing on the learning curve. It's also very affordably priced at \$100. For professional/prosumer editing, something like Sony Vegas Pro (or Final Cut if you're on Mac) is worth paying extra for the added precision

in editing and features they offer. But for cutting together something like a holiday video, birthday memories, or even a web show for YouTube and the like, Elements is plenty.

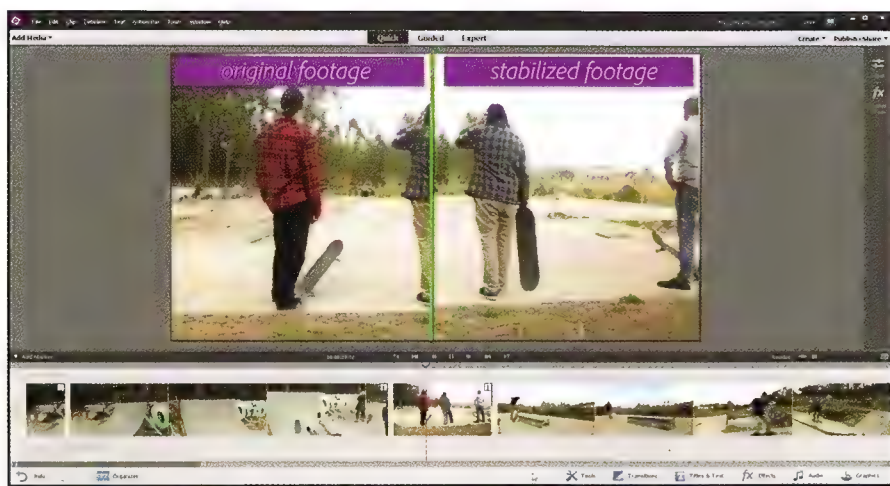
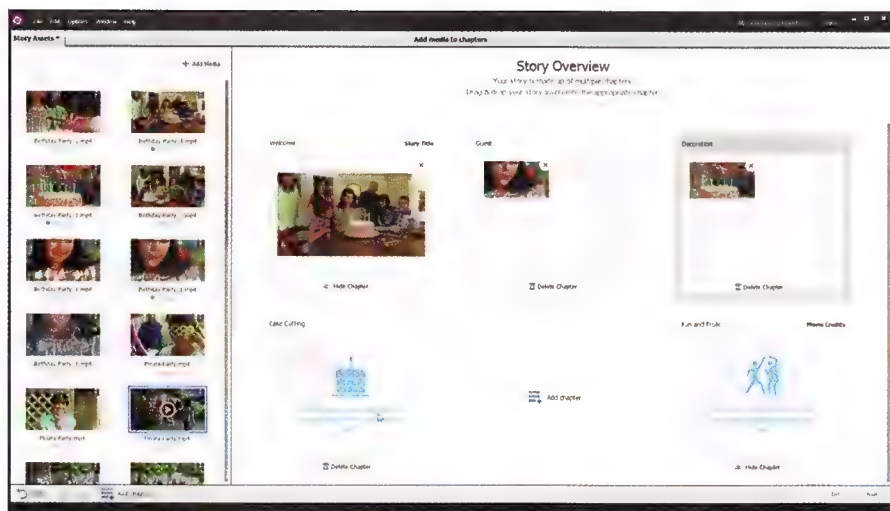
Elements 13 isn't a huge update on 12; the biggest under-the-hood change seems to be the somewhat belated support for Mac owners with Retina displays. As far as Windows-applicable editing features go, the two biggest additions are aimed at new users and those who want to get a movie made

without too much in the way of direct editing or squinting at clips. Video Story is a new wizard that offers templates such as Birthday, Wedding and Graduation. Each is a storyboard broken into pre-defined chapters such as 'Dressing Up' or 'Getting The Degree', with the option to add extras or delete any that you don't have footage for. Some take a single clip, others multiple (with Auto-Analyzer on hand to break up longer footage), with the Video Story combining and mixing them up with music, fades and looks. It's then possible to add captions and narration over the top. You can edit the default captions, and either publish the whole thing there or send it to the Timeline. The results are generic, but you can't argue with the speed.

A more useful addition is the Favorite Moments edit. This takes in an extended clip that you want to extract elements from, but instead of making multiple in-and-out cuts, it makes it as easy as scanning to the part you want, clicking a Mark button and adjusting the length of each selection before exporting just those bits to the timeline as a combined clip or a individual ones.

These two features (on top of an already excellent line-up) make 13 a great choice for new users. Other improvements are thin on the ground, however; it's hard to say they're \$100 worth of upgrade if you have version 12. There are new Guided Edits for putting video behind a title, and applying primitive effects masks, though the latter is let down by only allowing a hard-edged rectangular mask rather than feathering and circles. These aren't bad as one-time tutorials. After that, Elements 13 runs out of steam, with a few updates to features like the Shake Stabiliser, but nothing that's going to make a big difference. A pity, but there's always the next version...

Richard Cobbett



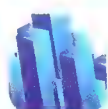


Mac » APPS

WALTR for Mac

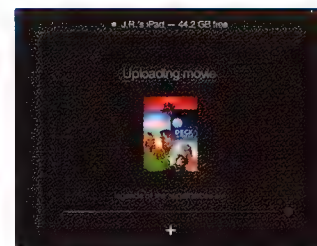
The best way to sync media to an iOS device.

US\$29.95 | SOFTORINO | WWW.SOFTORINO.COM



A new Mac application, WALTR, has managed to find a way to circumvent iTunes' rigid adherence to MP3/AAC and MP4 formats.

The process is a model of simplicity: launch WALTR without iTunes running, plug in any supported iOS device, then drag and drop your files over. After roughly 30 seconds, files are copied, ready for playback alongside previously synced media and iTunes in the Cloud content. The real trickery, though, lies in how the software deftly makes unsupported formats — MKV, AVI, FLAC, WMA and OGG among them — “just work” without the need for conversion software. Note that MPEG and Divx files are among the few formats the software currently rejects. Note also that WALTR will use the first image found inside a folder to create a thumbnail. For now, the workaround is to temporarily create new folders for each album/video with



only those media files and image; Softorino is working on a solution. The bottom line? WALTR is hands down the fastest, most user-friendly method we've ever seen for syncing music and videos to an iOS device, no iTunes required.

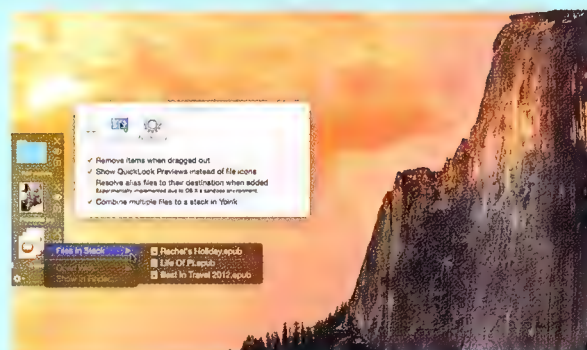
J.R. Bookwalter



Carbon Copy Cloner 4

\$45.99 | BOMBICH SOFTWARE | BOMBICH.COM

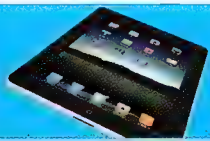
This app is invaluable for maintaining a bootable backup of your startup disk, and as a complement to Time Machine. Yosemite requires this version, and there's reason to upgrade on older systems, too. Chief among them is a new layout that consolidates task creation and scheduling, making things clearer at a glance. All that's required to make a bootable clone of your startup disk is to identify it as the source, choose a destination volume and, optionally, set how often the task will run. You can now modify tasks, rather than recreating them from scratch. In addition to running a shell script, you can mark another task to run. Handy if you want to, say, update your system clone on a local drive and then back up documents to a network drive in one session. Tasks can be monitored from a menu bar icon, instead of a progress panel blocking access to the app. Advanced users may be disappointed by the removal of a detailed activity log, but the History window that replaces it is easier to digest — a recurring theme in this version. Alan Stonebridge



Yoink

\$6.49 | ETERNAL STORMS | ETERNALSTORMS.AT

Transferring files from one place to another can be tricky. Yoink simplifies the process by providing a halfway house: a tray that slides out from the left-hand side of the screen for you to dump files, folders and selected app content (such as Evernote notes) into. You then navigate to your destination — another folder, app or even Space — and then drag your item from the tray into it. The simplified file transfer process is impressive enough, but Yoink goes further. You can store multiple entries in the tray at once and lock individual items so they remain in the tray for future use. One gripe is the built-in file preview, which currently doesn't work with certain types (iWork and Office among others) in Yosemite, but this is the only blemish on a program that otherwise absolutely delivers in spades. Spend five minutes with Yoink and you'll wonder how you ever did without it. Nick Peers



App Store » iOS APPS



Duet Display

A simple and effective way to use your iPad as a second screen for your Mac.

\$18.99 | RAHUL DEWAN | WWW.DUETDISPLAY.COM

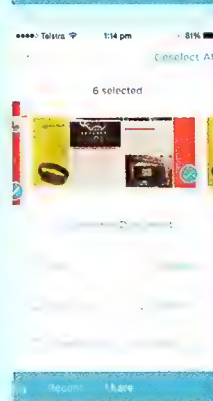
It's not uncommon for PC power-users to have a second display hooked up to their desktop and there've been plenty of studies over the last decade that seem to indicate having an extra screen can increase productivity (though some of those studies have been backed by monitor makers, so caveat emptor). Duet Display is a simple iOS app that'll let you use an iPad as a secondary display to a Mac – if the latter's a MacBook, that niftily means you could have a dual-display setup that's actually portable. The Duet iOS app itself is pretty light on options. It works in tandem with an OS X program that basically tricks your Mac into thinking the iPad is a standard secondary display and, using the OS X app, you've got a few performance/quality related settings you can adjust (such as framerate and resolution) to optimise the visuals or be more energy efficient. Is it perfect? Not quite. While it was mostly lag-free when used with a MacBook Air and iPad Air 2, doing intensive tasks on the Mac end could slow down cursor responsiveness. Duet also won't really work for gaming – try to run a Mac game in fullscreen on the iPad and what you get instead is a window in the corner of your main display. You do need to plug the iPad in to your Mac via USB, too. That price may seem a little high, too, but given the extra functionality it'll deliver for dual-screen aficionados, it could definitely be worth it. Dan Gardiner

Evernote Scannable

FREE | EVERNOTE | EVERNOTE.COM



Smartphone apps that scan documents aren't new and for a lot of them the focus is to get the highest-quality scan possible. This seems like a good goal right? Well, not really. When you think about it, the numerous scanning apps out there have shown that all those added features seem to max out at some point and end up slowing the whole process down. With Scannable, Evernote's aiming to turn that on its head, showing that the key to a good phone scanner is actually speed. The app identifies a document on the desk, takes a snapshot, crops it (and rotates it) all without pushing a button. The resulting image can be exported to Evernote for full text OCR, shared via email (among many other options) and the app includes text recognition and contact-creation from scanned business cards — it can even grab relevant contact details from Linked-In. Joel Burgess

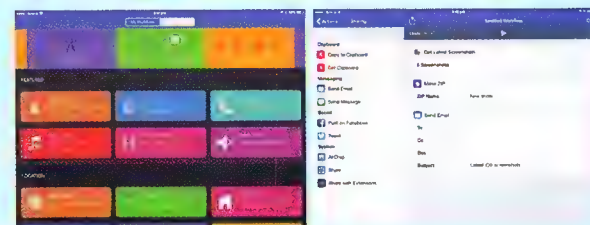


Workflow

\$6.49 | DESKCONNECT | WORKFLOW.IS



Workflow is basically the iOS answer to Android's Tasker app. Like Tasker, Workflow lets you chain together multiple OS actions (and interactions) to turn complex tasks into a simple one or two-button affair. With multi-tasking still clunky on smartphones and tablets, this is a great way to automate repetitive tasks and plug functionality gaps. Workflow has a bunch of these automated tasks already built-in — like the ability to stitch together a set of images into an animated GIF, call an Uber cab to your home address, shorten URLs or even do a mail merge. But you can add an almost infinite number of additional tasks through a drag-and-drop programming interface which, thanks to iOS 8's more-advanced app-to-app handover capabilities, can let you do things like save an email as a PDF and then upload it to your Dropbox. Workflow plugs into all sorts of third-party apps, so you can create quite intricate Workflows that switch back and forth between apps. If you've struggled with multitasking speeds on iOS, this is a great way to enhance it. Dan Gardiner





Google Play » ANDROID

Bleep (Alpha)

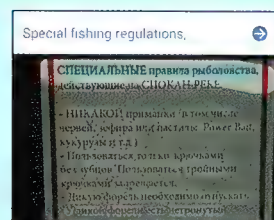
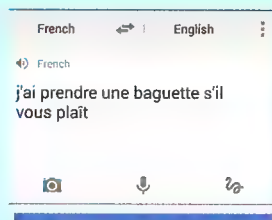
Make your phone calls and text messages more secure... with BitTorrent?

FREE | BITTORRENT | LABS.BITTORRENT.COM/BLEEP



BitTorrent, Inc has copped a fair amount of flack over the years (deserved or not) due to its widely used, law-straddling BitTorrent protocol.

With that in mind, it comes as no surprise that the company would develop a secure messaging app that wants to protect you from government surveillance and other unwanted listeners. Enter BitTorrent's new Android app, Bleep. Currently in the alpha stage, Bleep allows users to send text messages and make calls that are completely encrypted. Much like the company's torrent protocol, Bleep is a peer-to-peer client, so users can simply contact each other directly without their metadata passing through a central server. BitTorrent claims that it's "practically impossible" for someone to gather your metadata. Aside from the Android version, Bleep is also available for Windows 7 and 8, and Mac, with an iOS version currently in development. While there are certainly some bugs that need ironing out, we expect that Bleep will fix its niggling problems when it enters its next stages. **Stephen Lambrechts**

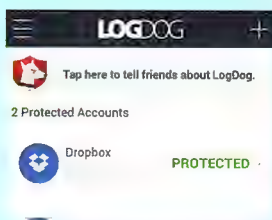


Google Translate

FREE | GOOGLE | TINYURL.COM/APC412-TRANSLATE



There are a number of new features in Google's latest update to its Translate app that make it rather exceptional. Available on both iOS and Android, the standout feature has to be the inclusion of Word Lens — an app that Google acquired last year along with the company that made it. Using your smartphone's camera, Word Lens lets you to take a snapshot of a street sign, menu, bus destination or anything else that you come across in a foreign country and translate it into the language of your choice. What's more amazing is you don't even need the internet to do this. Google's also claiming that a massive overhaul of the live voice-translation section will allow people of different tongues to have a more fluid conversation. APC hasn't tested the accuracy in a full-on multilingual dialogue yet, but even trying out a few basic French phrases were enough to bring out some imperfections — this is still a long way from Star Trek's Universal Translator. Grab the update though. **Joel Burgess**



LogDog

FREE | GETLOGDOG.COM



If the recent security-scare from Sony Pictures proves anything, it's that the internet is far from secure, with cyber attacks and hacks capable of taking down even the biggest targets. It's an alarming realisation, especially considering many of us are increasingly storing our personal information online. LogDog is a service aimed at giving you another layer of online security beyond what your antivirus provides. It works by constantly monitoring your online accounts for any suspicious activity or unauthorised access, alerting you immediately if it finds anything suspicious. It then guides you through securing your account again. While the app is relatively simple, its ability to alert you immediately could potentially mean the difference between an unauthorised purchase on your credit card, or even worse, that photo you took at your friends bachelor party becoming public! Currently the service supports Gmail, Facebook, Yahoo, Dropbox and Evernote, with more to come. **Tim Bothwell**



Microsoft Cortana (Alpha)

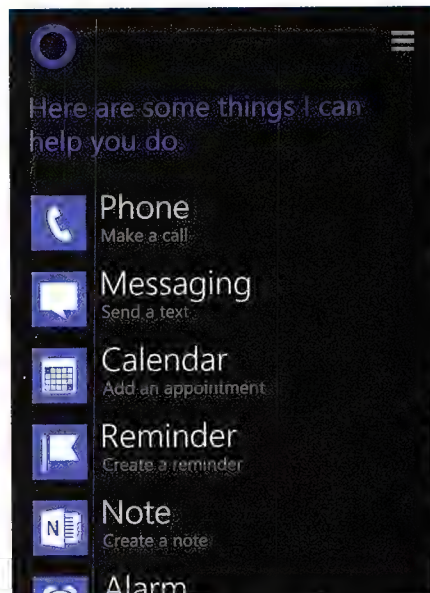
Is Windows Phone's virtual PA finally something iOS and Android owners should be jealous of?

FREE | MICROSOFT | [TINYURL.COM/APC412-CORTANA](http://tinyurl.com/APC412-CORTANA)



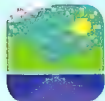
Cortana's often described as Windows Phone's answer to Apple's Siri (or Android's Google Now), but ask her (and yes, Cortana identifies as female) how she compares with the latter and she'll tell you that she is — in effect — far superior.

The virtual assistant of the new Windows Phone 8.1 OS is still in alpha phase in Australia, and she's been a long time coming. Powered by Microsoft's Bing search engine, Cortana's actually surprisingly useful and functions quite well against the competition. Ask if there are any good restaurants nearby and she will bring up a list ranked by reviews. Cortana will then refine that list if you ask 'which ones take reservations', showing that she recognises chains of questions. You can even set up reminders to ask people about specific topics when you talk to them next, a particularly useful forte for a personal assistant. Though at times, Cortana can perhaps rely a little too heavily on Bing's search engine and there are still some key features that need fleshing out in the local version. Still, if you're a Windows Phone user, she's definitely worth a try. **Joel Burgess**



8-Bit Weather

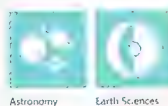
FREE | PIXEL8 | [TINYURL.COM/APC412-8BITWEATHER](http://tinyurl.com/APC412-8BITWEATHER)



We know what you're thinking. Seriously... another weather app? Most of them are about as uninteresting as an overcast day. It doesn't have to be this way though. Drizzle would actually matter to an army of medieval knights, planning on going to battle. Being able to look out the window of your own castle to discover those dark stormclouds is far more interesting than a sterile image of a sun on a blue background. And what could be better than rendering your very own castle in 8-bit. The nostalgia bound to retro games — and the public's reinvigorated appreciation for them — makes 8-bit Weather a great app to pledge your allegiance to the perfect pixelated platform. Simple and functional, 8-bit Weather has temperatures in both Fahrenheit and Celsius and can give you current conditions or hourly/weekly forecasts. APC just can't wait till local weather data is actually incorporated into an open world game... 8-bit Weather Wars, anyone? **JB**



examples history fav



projectile

$$h = \frac{v^2 \sin^2(\alpha)}{2g} \quad x = \frac{v^2 \sin(2\alpha)}{g}$$

$$T = \frac{2v \sin(\alpha)}{g}$$

T travel time
v initial speed
 α release angle relative to horizontal

WolframAlpha Course Assistants

FROM \$1.99 | WOLFRAM GROUP LLC | [TINYURL.COM/412WOLF](http://tinyurl.com/412WOLF)



WolframAlpha is the software you'll find embedded into Apple's iOS assistant Siri, but this comprehensive, interactive database of science, mathematics, history, linguistics and medicine goes far beyond Siri's simple tricks. Taken as a whole, it's an astounding source of synthesized information. It just got a little bit more accessible thanks to this new Windows Phone app. For anyone doing mathematics at university (or just for those with a keen interest in numbers), you'll find a comprehensive set of course assistants. These assistants not only offer an encyclopedia of everything you could want to know about your course, but will also let you plug equations into WolframAlpha's supercomputers over a Wi-Fi or 3G/4G connection, solving them in real-time and even running you through a step by step process of how it did so. The assistants range from \$1.99 to \$4.99 each. **Joel Burgess**

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Feb 2015 Issue 412

HACK GOOGLE'S CHROMECAST! Android expert Darren Yates shows you how

2015 TECH PREVIEWS We uncover all the big PC & tech changes coming this year

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A MORE POTENT
PORTABLE

Upgrading to a new OS

There are multiple ways to install a new OS, depending on what else you want to upgrade. Darren Yates explains the ins and outs.

According to the latest numbers from Netmarketshare as of December 2014, Windows XP still had just over 13.5% market share on desktop PCs globally – that's an astonishing number for an OS released 13 years ago and abandoned last year. If you're one of those 13.5% and ready to upgrade, it's important to consider the rest of your PC before you jump. XP requires less RAM and storage space compared with newer Windows releases, so jumping to Windows 7/8/8.1 may see you short of RAM, storage or both, particularly if it's an older XP box.

If you don't have at least 1GB of RAM (preferably 2GB), you'll need to fix this up first, but bottom line, upgrading an OS can be somewhat more problematic the older your PC is – but here's how you can make it easier on yourself.

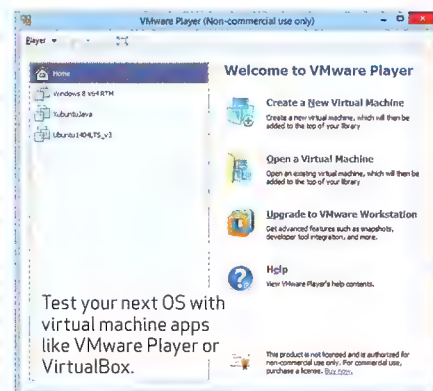
CONSIDER A HARD DRIVE UPGRADE

If your PC has a SATA interface, the least troublesome option could well be to just purchase a new hard drive, install your new OS on that and keep

your existing XP hard drive as a ready-made backup. Windows comes with an option to upgrade from one OS to another on your existing hard drive, but there are reasons I don't use it. First, it works only on incremental upgrades – you can't jump from XP to 8.1. Second, you need to backup your important files from that original drive before you perform the Windows in-OS upgrade. If you don't backup and the upgrade goes pear-shaped, you may lose the lot. Third, if it's an older drive, it could be well close to retirement anyway and not up to the rigours of a new OS.

There are potholes on the road to a new drive, however – first, make sure your motherboard supports the new drive capacity. Pre-UEFI boards won't handle anything beyond 2TB as a system drive and depending on the age of your PC, you may struggle even with 500GB drives. While it's tempting to go straight for an SSD here, older boards without SATA-III interface support won't push an SSD to full tilt, meaning you'll see little improvement. In that case, stick to a standard hard drive.

Any system without a SATA interface



I would leave alone and pension off.

I prefer this upgrade path for two reasons – you get a fresh install that's guaranteed to run clean and fast, plus, you also get to keep your old OS setup as a backup you can still plug back in. Yep, it does mean reinstalling your apps on the new drive, but I'd prefer that and to keep the original rather than upgrade, find apps no longer work and no way to go back.

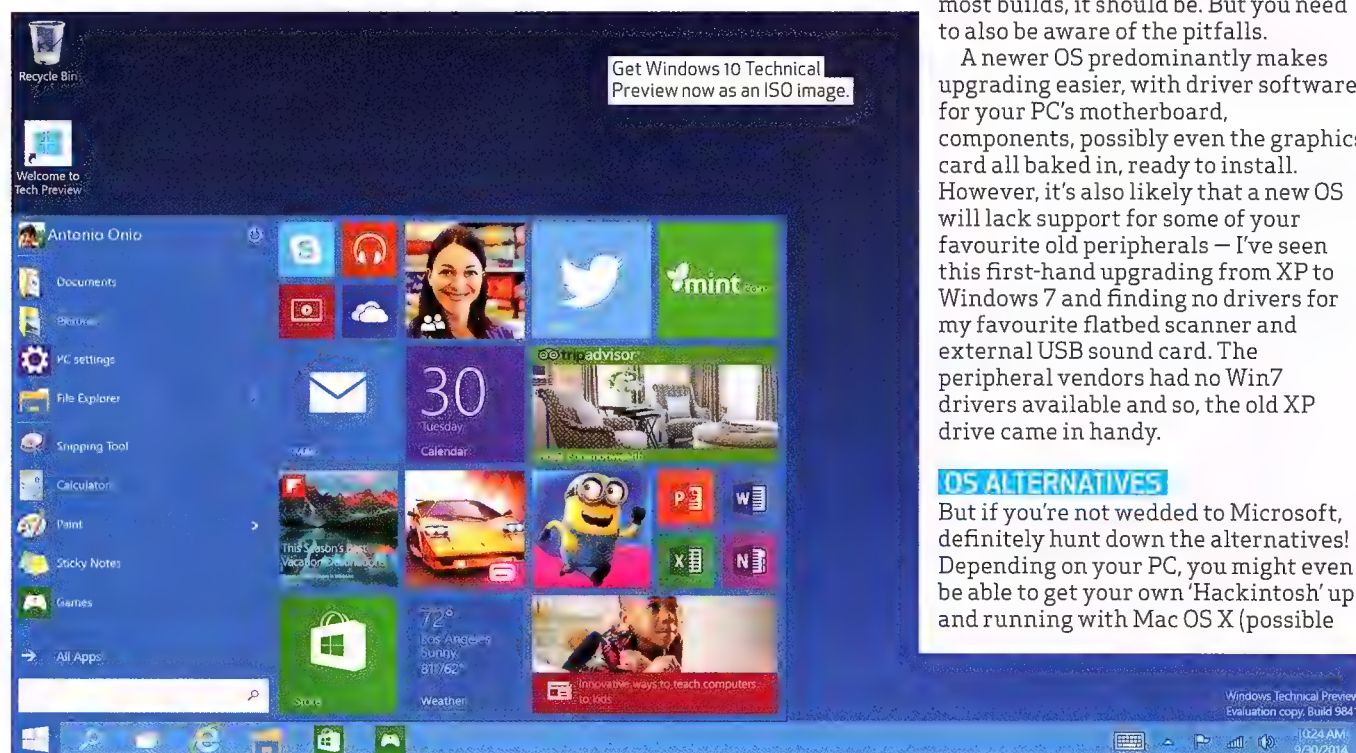
WINDOWS UPGRADE PROBLEMS

We'd all love an upgrade process that's a perfect no-worries ride – and for most builds, it should be. But you need to also be aware of the pitfalls.

A newer OS predominantly makes upgrading easier, with driver software for your PC's motherboard, components, possibly even the graphics card all baked in, ready to install. However, it's also likely that a new OS will lack support for some of your favourite old peripherals – I've seen this first-hand upgrading from XP to Windows 7 and finding no drivers for my favourite flatbed scanner and external USB sound card. The peripheral vendors had no Win7 drivers available and so, the old XP drive came in handy.

OS ALTERNATIVES

But if you're not wedded to Microsoft, definitely hunt down the alternatives! Depending on your PC, you might even be able to get your own 'Hackintosh' up and running with Mac OS X (possible





Beware using drives larger than 2TB on older systems — they may not recognise them.



SSDs are great for OS speed, but only with SATA3 and minimum Windows 7..

with many Intel Core 2 Duo or newer boxes). But the most practical option is the various Linux distros available. For older systems, a good option is Xubuntu (www.xubuntu.org) — it uses the Xfce desktop environment that isn't as heavy as KDE, Gnome or Unity, it's still rich in features and will run almost all Linux apps. It's just a more lightweight form, ideal for older single and dual-core CPU'd/sub-2GB RAM builds.

RECOMMENDATIONS FOR OLDER SYSTEMS

Unless you're running off the grid, XP systems connected to the web need an upgrade for security's sake, if nothing else. If the thought of Windows 8 makes you gag, many retailers still sell OEM copies of Windows 7, but if your older PC can handle it, Windows 8.1 might be worth it to get the latest software/hardware support. If you can't stand the Modern UI, just grab Classic Shell (www.classicshell.net) and you'll get your Start menu back again. Be aware that an OS upgrade may leave you needing new peripherals, components and whatnot,

depending on the age of your existing gear and available 8.1 driver software.

If you're tossing up whether to give Linux a go, our tips are:

- Try it first on a virtual machine (VirtualBox or VMware Player 7 should be fine)
- Go for a distro with long term support (LTS)
- Choose a 64-bit version if your CPU can handle it.

RECOMMENDATIONS FOR NEWER BUILDS

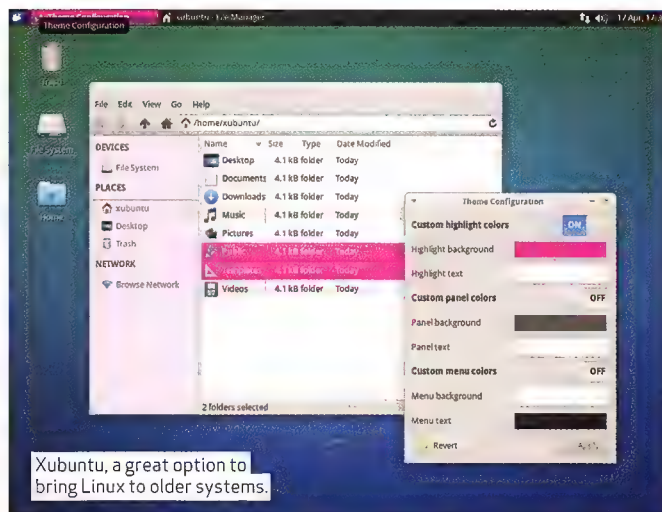
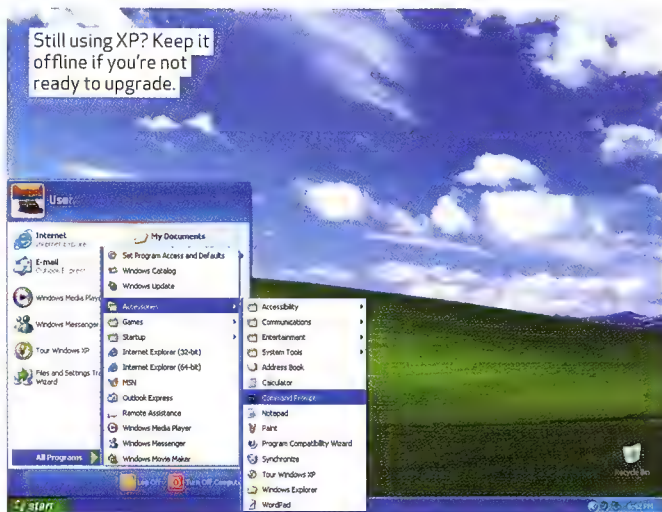
If you have a late-model PC (no more than four years old), get a look at the latest Windows 10 Technical Preview (tinyurl.com/pq6pqzq) and again, try it out on a virtual machine or a second system. If it looks good to you, wait for the release later this year. If you're still running Windows 7, we'd stick with it — there's probably not much point upgrading to Windows 8.1 at this stage. At least not until Microsoft announces a free Windows 10 upgrade for Windows 8.1 buyers. In the meantime, just save your pennies, sit tight and wait.

New for 2015

This will be a big year for OS releases, as Microsoft readies Windows 10 for launch later in 2015. With more than half of all Windows PCs still running Windows 7, we should see whether the market continues its apparent 'buy one, skip one' relationship with the Microsoft OS.

It's also likely to be a big year for Linux. Vivid Vervet (Ubuntu 15.04) arrives sometime around April, but the controversial forking of Debian late in 2014 will have battlelines drawn early, with the latest Debian-stable 'Jessie' due possibly as early as February and the new Devuan 1 distro arriving around March-May this year. (Not to mention new Linux Mint and other distro flavours also expected.)

Apple is also now on a yearly update cycle, so expect Mac OS X 10.11 towards the end of 2015. ■



Xubuntu, a great option to bring Linux to older systems.

A new CPU

Upgrading a CPU isn't impossible, but it's not as easy as it looks. Darren Yates reveals how to avoid the pitfalls.

Upgrading your PC's CPU really would make for the simplest system upgrade — just pop the cooler off, swap the chips over and enjoy that extra new zip, all in about ten minutes. No swapping motherboards, hard drives or anything else. But the reality these days is that CPU upgrades are a minefield seemingly guided more by luck than management.

INTEL OPTIONS

Unless you have an 8-series board under the bonnet, your Intel CPU upgrade options are mostly done and dusted. Intel's penchant for changing CPU sockets on the release of a new CPU family leaves LGA1155 as the only socket platform to have seen off more than one CPU generation in the last six years. However, the only 3rd-generation LGA1155 chips you'll still see available today are occasional Xeon E3v2 quad-core models, or whatever Ivy Bridge leftovers you happen to find on eBay.

There is potentially better news for the current LGA1150 platform, which saw a modest Haswell refresh late last year, usurping the Lynx Point 8-series chipset with a minor Devil's Canyon 9-series upgrade to Z97 and H97 variants. The good news is the new Haswell-refresh CPUs will run on 8-series boards, but will need a BIOS update prior. Haswell-refresh CPUs are really only speedbumps still considered '4th-generation', so for now Devil's Canyon is more of a holding pattern until 5th-gen Broadwell hits sometime mid-year. However, the rumour is Broadwell CPUs will also use LGA1150 — whether that means 8-series boards as well as 9-series, we won't know definitively until closer to Broadwell's expected mid-year desktop launch.

AMD OPTIONS — AM3-SERIES

By contrast, AMD might not have the same straight-line speed of similar-generation Intel CPUs, but it's generally had the much better CPU upgrade path, thanks largely to AMD's long-lived AM-socket series. However, with AMD pushing hard with its A-series application programming unit (APU) development, the AM3+ platform release schedule resembles



New Z97 boards may be able to run Broadwell CPUs later this year.

"SEATTLE" SOC OVERVIEW

Power Efficient Cores

- Up to Eight ARM Cortex-A57 cores
- Up to 4MB shared L2 cache total

Cache Coherent Network

- Full cache coherency
- 8MB L3 cache
- SMMU: I/O address mapping and protection

High Performance, Flexible Memory

- Two 64-bit DDR3/4 channels with ECC
- Two DIMMs/channel up to 1866MHz
- SODIMM, UDIMM, RDIMM support
- Up to 128GB per CPU

Highly Integrated I/O

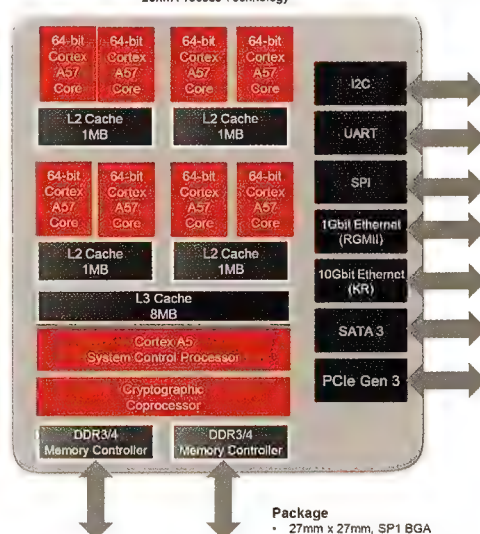
- 8x SATA 3 (6Gb/s) ports
- Two 10GBASE-KR Ethernet ports
- 8 lanes PCI-Express® Gen 3, supports x8, x4, x2

System Control Processor

- TrustZone® technology for enhanced security
- Dedicated 1GbE system management port (RGMII)
- SPI, UART, I2C interfaces

Cryptographic Coprocessor

- Separate Cryptographic algorithm engine for offloading encryption, decryption, compression, decompression computations



3 | AMD "SEATTLE" | HOT CHIPS 26 | 11 AUGUST 2014

AMD's Opteron A1100 brings tablet CPU power to power-efficient servers.

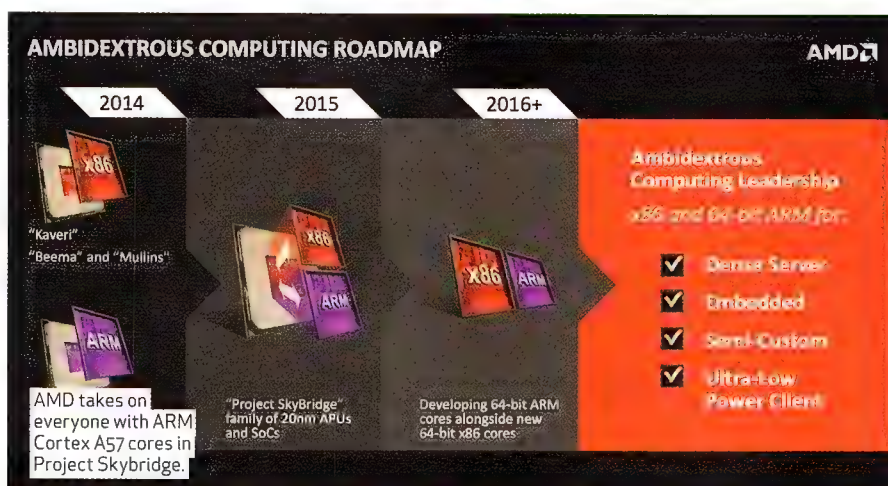
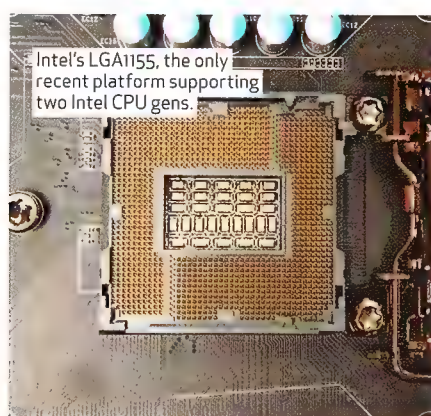
tumbleweeds rolling across the open plains. Still, online retailers have stock of numerous recent Piledriver-class multi-core FX series chips that plug right into AM3+ boards — the four-core FX-4300, six-core FX-6300 and eight-core FX-8320, FX-8350, FX-8370, FX-9370 and FX-9590 are still common amongst the online retailers we checked with.

But if your AMD box predates the AM3+ socket, there's still a chance an upgrade path exists. We've seen a number of retailers continue to stock the old Phenom II X2 565 dual-core

CPU — this is a Socket AM3 chip, which is good news for owners of even older systems. AM3 CPUs can generally be installed into ageing AM2+ and AM2 socketed boards, albeit with reduced performance and you must make sure your board has BIOS support for the new chip, otherwise, it probably won't work.

THE KEY TO CPU UPGRADES

This is the key to any CPU upgrade — your board must physically support the CPU, yes, but without the right BIOS firmware, the board won't likely



recognise or power it. That means checking the CPU support list page for your motherboard before you buy. You'll need to compare the required minimum BIOS version listed with the version your board currently runs and if it's behind, update it with your old chip in-place before swapping over to the new one.

IS IT WORTH IT?

But after all this, there is the other question you need to ask yourself, namely whether the upgrade is actually worth the effort. The dual-core Phenom II X2 565 is effectively the last AM3 chip available, but if your old system is already running a quad-core Phenom or Athlon II X4,

you'll need to decide whether or not you'll be better off with the new chip. The 565 sells for only \$60, so as a backup, it might be worth it — but it's unlikely it'll overtake a quad-core CPU. As we said, you'll have to decide.

And for that reason, we generally think CPU upgrades aren't worth the hassle. By the time you've changed the CPU and motherboard, chances are the hard drive is ready for retirement and by that stage, you might as well start from scratch. Still, there will always be exceptions such as those mentioned. We'd also include your home media server loaded with all your cough-legal-cough movies in that — rebuilding a media server isn't something you'd wish on anyone!

New CPUs in 2015

Intel's fifth-generation 'Broadwell' Core mobile processors have arrived for notebooks and tablets — we're told Broadwell will make its desktop appearance mid-year.

Based on the mobile offerings, we can expect greater power-efficiency, faster graphics and better video encoding speed, thanks to the CPU's new 14-nanometre build scale. Broadwell successor Skylake is roadmapped to arrive late-2015.

AMD also has a 'mobile first' focus these days, but while it won't match Intel for speed or transistor size (AMD may hit 16-nanometres late-2015), it has potentially the more interesting silicon. AMD is a paid-up member of ARM's designers club and late last year, pushed out the first development kits for its Opteron A1100 server chips, running eight 64-bit ARM Cortex A57 cores. This year, we'll see 'Project Skybridge' combine new AMD-designed 'K12' Cortex A57 cores with AMD's own x86 processors into a single chip. Forget choosing between Windows and Android — the possibility of having both run natively on the same device is a compelling concept.

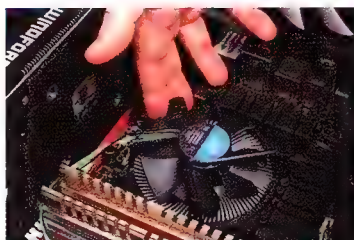
CPU RECOMMENDATIONS

If you're set to upgrade an Intel 8-series build, the Core i5-4690 (or 4690K, if you intend to overclock) would be our choice. In most benchmarks, it delivers around 90% of the performance of the top-drawer Core i7-4790's, at only 75% of the price. However, the caveat is that upgrading to the 4690 is only worth it if you're replacing a Core i3 or Pentium G-series chip. The 4690 should work in older Z87 boards too, but check your BIOS version first.

Budget builders could do worse than start from scratch with Intel's Pentium G3258 Anniversary Edition — a basic but very overclockable dual-core CPU for under \$100.

AMD system builders sticking with AM3+ should look at the FX-8320 — it's about \$40 cheaper than the FX-8350 and the minimal difference in clock speed can usually be made up quickly in overclocking.

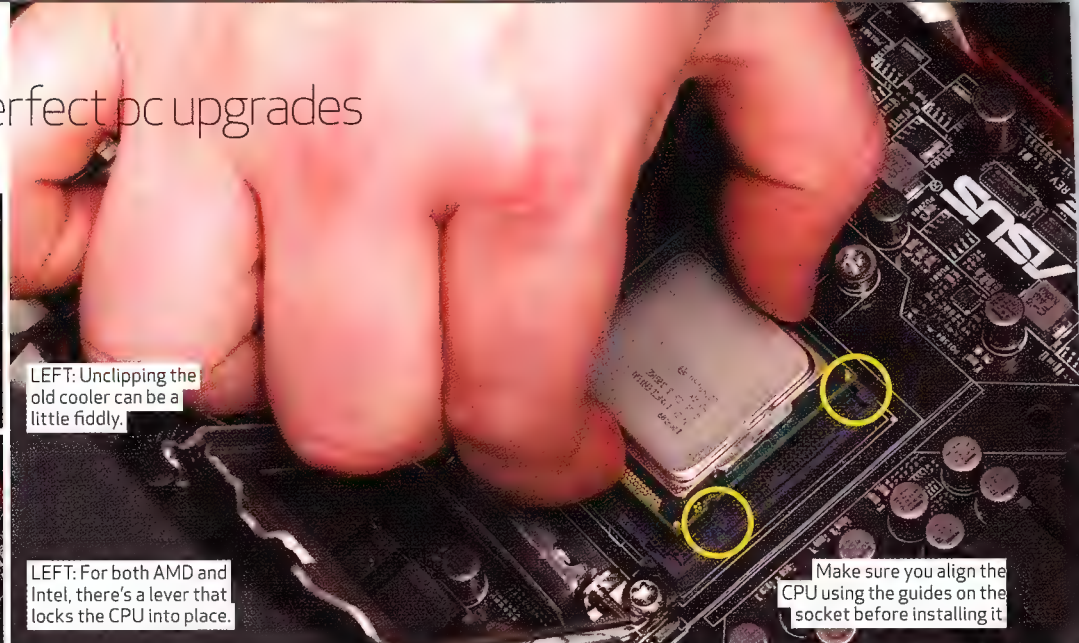
As for the best overclocking AMD option, that's a bit of a lottery — rumours that the FX-9590s are just factory-overclocked FX-8370s certainly won't help. There are no guarantees — it more just comes down to getting an eight-core chip and whether or not you feel lucky (and don't need your warranty, of course). ■



LEFT: Unclipping the old cooler can be a little fiddly.



LEFT: For both AMD and Intel, there's a lever that locks the CPU into place.



Make sure you align the CPU using the guides on the socket before installing it

Upgrade your CPU

The quick and easy guide to installing a new processor. Dan Gardiner

Swapping over a CPU should only take around 10 minutes at most, and the process is roughly the same for both AMD and Intel chips. The main difference being that AMD CPUs have connector pins, while Intel CPUs have moved these pins to the socket. It's these pins that are the most easy element to damage – something that can render the CPU (AMD) or motherboard socket (Intel) unusable.

CHECK YOUR BIOS

Before we do anything with the hardware, double-check that your BIOS is up to date and supports the new CPU you intend to install. If you're unsure what motherboard you have, download and install HWiNFO (www.hwinfo.com), then run it and in the 'System Summary' window, you'll find your motherboard name as well as the specific version BIOS. Next, head to your motherboard maker's web site, navigate to the support page for your board and check for newer BIOS downloads. Flashing a new BIOS is usually a matter of copying the file to a USB key, then rebooting, going into CMOS setup and launching your board's built-in BIOS flashing utility.

REQUIREMENTS

For this tutorial, we're assuming you have a full retail CPU kit, including new chip and cooler. Our photos are from an Intel install, but the process is almost the same for AMD CPUs, with one or two slight differences that we've outlined in the text where relevant. Before you get started, we'd recommend wearing an antistatic strap to prevent damage while handling the CPU. While we've double-checked these instructions, following this

tutorial is done at your own risk – we can't offer any support should something go wrong. Here we go!

SWAP OUT A CPU

1 Unplug your PC from mains power and lay it flat on a table, then remove the screws holding the side (or sometimes top) of the case in place and take off the side panel. You'll see the guts of your PC. Carefully unplug the cooler's power cable from the motherboard.

2 Now we'll remove the CPU cooler. For stock Intel coolers, this involves rotating four pin-locks 90° and then, one by one, pulling them up gently to release them. For AMD, flip the lever on the side of the cooler to release the bracket, then unhook it from the back and front of the CPU socket. Carefully lift it away, being careful not to get any thermal paste onto your skin.

3 On the side of the CPU socket, you'll find a lever that locks the CPU into place. Lift it up to release the CPU – on Intel sockets, this requires pulling it sideways away from the socket first, then fully flipping the metal cover back to expose the chip.

4 Very carefully remove the CPU – it's important not to damage the pins that the CPU connects to the socket with – and temporarily place it in a safe place, like on a piece of foam or a few folded tissues.

5 Take your new CPU from its packaging and then orient it properly to match the socket. On Intel CPUs there are two indents that you can use as a guide. On an AMD chip, find the corner with the gold triangle and match

that to the socket corner with a triangle emblem. Now place it into the socket. Never push a CPU into place – if it's aligned correctly, it should simply drop straight in. Turn the lever and, for Intel chips, slide the metal cover back in place to lock the CPU into the socket.

6 Take the new CPU cooler from the packaging. The cooler should already have some thermal paste applied to it, but if not, squirt a very small amount on the CPU and spread it out to cover most of the chip. It should literally be as thin as possible – about half a millimetre thick – and you can use the edge of a business card to spread it. Carefully line up the cooler so that the clips match the socket/board, then place it on top of the CPU.

7 For Intel boards, reinsert the locking pins into the holes on the motherboard and push down gently until they click into place. For AMD, reattach the metal clip on the hooks at the back and front of the socket, then turn the lever to lock the cooler in place. Plug the CPU power cable into the appropriate socket on your motherboard.

8 Screw the side of the case back in place and plug your PC back into the power and its peripherals. Turn it back on and, if everything's gone to plan, it should switch on and give you a "new CPU" prompt – press the appropriate keyboard key and it should boot your OS!

9 Optionally, you should be able to store the old CPU and cooler in the now-empty packaging from your new one, which will stop thermal paste getting everywhere. ■



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How much RAM?

It's easy to spend too much on memory, particularly for older systems. Darren Yates uncovers the sweet-spots for RAM upgrades.

When Windows XP arrived back in 2001, 256MB of system RAM was quite common. Today, many PCs are running at least 8GB of RAM – a 32-times increase. A PC with less than 1GB of RAM can seemingly gain in performance when given a memory upgrade, simply because you're giving the OS the oxygen required to breathe. Starting with more than 1GB and an upgrade instead enables more efficient hard drive use and greater app concurrency. They're the basic nuts and bolts of what a RAM upgrade usually offers – choosing the RAM itself and whether or not it's worthwhile is the more complex story.

HOW MUCH IS ENOUGH?

If you're still running a 32-bit version of Windows, there's no point running more than 4GB of RAM, simply because the OS cannot address more than about 3.3GB of it and the rest is wasted. By contrast, Windows 64-bit can make use of whatever RAM you throw at it.

As for how much, Windows Vista/7/8/8.1 will function with just 1GB of RAM, but we'd suggest twice that for each core your CPU has – for example, 4GB for a dual-core box, 8GB for a quad-core system – to get maximal value from your hardware.

If you've got an SSD as your system drive on a performance PC, there's a case for doubling it again. The reasons are two-fold – first, the SSD read bandwidth makes having the extra RAM worthwhile, but second, the extra RAM reduces the need to pagefile data to the SSD, extending its life.

SELECTING RAM

Memory modules might be easy to install, but choosing the right option for your setup can be a minefield. Not only do you have multiple specs to consider from capacity to speed and latency, there's also the motherboard manual fine-print about what you can and can't do. For example, ASUS' H81-Gamer has four DIMM slots, handles up to 8GB per slot, but only 16GB in total. Further, use all four slots and only single-sided (SS) modules are



DDR3-1600 RAM is the sweet-spot for price and performance right now.

allowed, plus the transfer rate is locked to DDR3-1066, regardless of the RAM speed. ASUS' H97-Pro Gamer, by contrast, handles a full 32GB complement from its four slots and supports speeds up to DDR3-2400.

But in most memory upgrades, the more pressing issue is working out just what you can add to what's already there. In general, you can mix and match RAM stick capacities – even modules with different speeds, but they will always run at the speed of the slowest stick.

Working with dual memory channels can also be confusing. The idea is that to enable dual-channeling, you should keep memory in pairs across the channels, so with slots labelled A1, A2, B1 and B2, for example, fill slots A2/B2 with the same RAM first, then A1/B1.

IS IT WORTH IT?

Unlike most other tech, DDR-class RAM becomes more expensive the older it gets. While you won't find DDR (Gen-1) RAM any longer, DDR2 RAM is available at some retailers but costs double per GB compared with garden-variety DDR3 memory. You'll pay around \$45 for a 2GB stick of DDR2 RAM, about the same price as a 4GB stick of DDR3. New DDR4 RAM for Intel X99 boards is also up around the \$20 per GB mark, so if you need a DDR3 RAM upgrade, now is the time to buy.

However, if you're upgrading an older box, we wouldn't recommend spending up big on older RAM. The performance levels of older systems now are such that anything more than 4GB of DDR2 RAM would be mostly pointless.

RAM SPEED

Right now, with DDR3 RAM the most affordable architecture, DDR3-1600 RAM is the price/performance sweet-spot, simply because it is the fastest RAM supported by just about every board. Anything beyond DDR3-1600 generally requires higher-performance chipsets.

Moreover, we take a conservative view that there's little point paying the premium for high-speed RAM until you've exhausted the upgrade paths of your CPU, GPU and storage first.

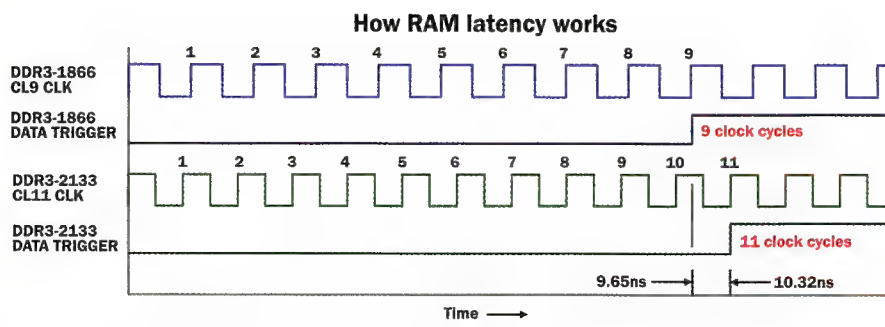
It makes more sense to go for an unlocked K-series/Black Edition CPU, faster graphics card and SSD storage before you start thinking DDR3-2400 RAM will help speed your system. We've carried out multiple tests over the years in APC Labs on this and we've never seen much more than 2-3% performance improvement on different benchmarks.

RAM LATENCY

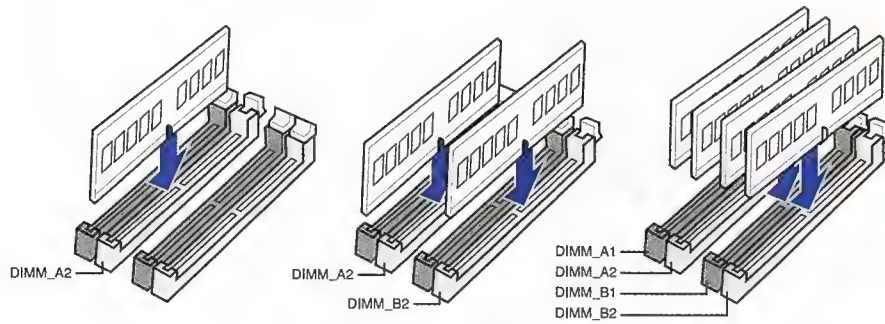
Arguably the most complex RAM concept to understand is latency. The megahertz (MHz) rating tells you how fast a memory module runs, but the latency tells you how long it takes (the 'delay') to respond to data requests.

The key latency spec is the CAS (column-address strobe) and it's measured in clock cycles. In retail specs, it's usually written as 'CL' for 'CAS Latency', followed by a number, for example, 'CL9' means a CAS latency of nine clock cycles.

Here's how latency can affect speed in an unusual way – a stick of DDR3-1866 'CL9' RAM will run on a 933MHz clock with a 9-cycle CAS latency while



ASUS shows how to use dual memory channels on its H97 PRO GAMER board.



CAS Latency (CL) is the delay before data delivery begins (see text).

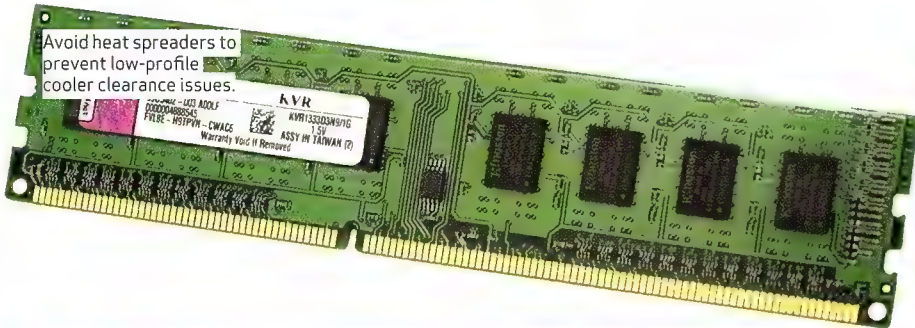
a DDR3-2133 CL11 RAM stick runs a 1066MHz clock with 11-cycle latency. To respond to a data request, the DDR3-1866 RAM will take 9/933-microseconds (9.65-nanoseconds) whereas the DDR3-2133 RAM needs 11/1066-microseconds (10.32-nanoseconds).

So here, a slower DDR3-1866 RAM stick responds faster than the supposedly faster DDR3-2133 stick. However, the faster clock rate of the DDR3-2133 stick should see it eventually pull ahead, provided the required data stream is sufficiently

large. In the end, high-speed low-latency RAM is the 'holy grail' for overclockers and where you pay a premium.

BUY SMART

RAM needs have more or less doubled every two years or so for the last 20 years since the launch of Windows 95. For the average user, concentrating on 'more' rather than 'faster' has been the underlying theme – something to bear in mind for your future upgrades.



What's new in 2015

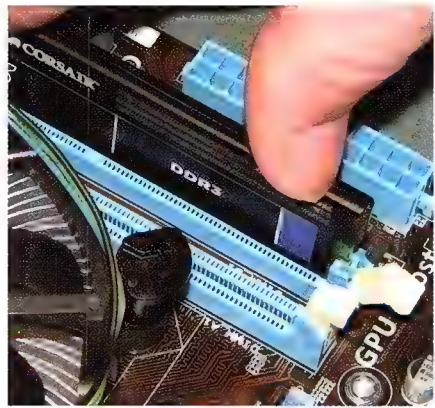
After arriving on top-drawer X99 chipset boards late last year, DDR4 may hit mainstream Haswell (Core 5) and Skylake (Core 6) boards later this year. Intel introduced a new UniDIMM (universal DIMM) standard at the back-end of 2014 for notebooks to accept both DDR3 and DDR4 chips, but given Broadwell desktop chips are expected to run on current Devil's Canyon (9-series) boards, it should at least work with DDR3. DDR4, mainstream, is more likely with Haswell-successor Skylake.

How to install RAM

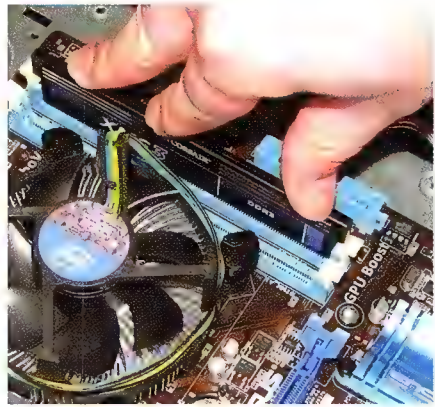
It's simple.



1 After powering down you PC, removing the power cable and opening up the cover, locate the RAM DIMM (dual in-line memory module) slots on the motherboard. Pull back the rocker clips on each side. If you are removing existing RAM, it should now pull free. Align the notch in the new RAM module edged connector with the same in the DIMM slot.



2 Insert the RAM module into the slot using the guide slots at each end.



3 Carefully but firmly press the top of the RAM module until the rocker clips lock into place. ■



Fast and affordable, Sandisk's Ultra Plus is a good bet.

Faster and fatter storage!

Solid-state drive prices continue to drop through the floor and traditional drives are bigger than ever! Now's a great time to upgrade your storage, says Ashton Mills.

The storage subsystem often gets a look in last, after the powerful upgrades of the CPU, GPU and memory. And, by virtue of the fact that storage is still the bottleneck of the modern PC – remembering that anything you run has to be loaded from storage first – it pays to give it a fair consideration in your budget. Any improvements in the storage subsystem will translate to overall better system performance.

While this is true, it's not as simple as just buying the fastest drive. For one, like everything else, you get what you pay for and secondly, we have a choice between SSDs and HDDs. SSDs clearly have the performance crown, but their cost per gigabyte still can't match the volumes of HDDs – which have now hit a mammoth 8TB.

For this reason you ideally want to have a little of both: an SSD for the operating system and any applications you want to be fast, and an HDD for more general storage.

If you're upgrading an older

machine, you'll already have what is probably a decent-sized hard drive and simply adding an SSD to the system can breathe new life into it. This is especially true of older laptops, where the super-fast speeds of an SSD can supercharge a system with aging CPU and memory.

For a new machine, you'll want to budget for one of each. This is because the difference an SSD makes can't be overstated enough, and there are sizes to suit all levels of budget (at a minimum, even a 64GB SSD is enough for the operating system and plenty of your favourite programs).

If budget isn't a concern, you might have the option of choosing a purely SSD-based system, assuming you have enough space to fulfil your needs. That said, even if you can afford it, this may not be the best route: most of us actively use only a small portion of the data on our drives, and some data doesn't need speed – music, movies and photos for example, which collectively make up a large chunk of storage for

a lot of us. Storing this on a cheaper, and larger, HDD is cost-effective without impacting the performance of your PC.

RECOMMENDATIONS

As with the other sections in our feature, we'll break down our recommendations into the three categories.

BEST BUDGET DRIVES

A 128GB SSD can be had for as little as \$70, such as SanDisk's Ultra Plus, which paired with a 1TB Seagate Barracuda 7200RPM drive also at around \$70 should be plenty for your needs (media pack-rats notwithstanding!). Why not a 500GB drive? The same Seagate Barracuda model in 500GB is only the cost of two coffees cheaper, which only goes to show just how cheap storage has become.

If you have a bit more money to throw around stretch the SSD to a 256GB model, the same SanDisk Ultra Plus at 256GB costs \$130, and you'll have room for Windows, all



Crucial's M100 line is a close tie with Samsung's EVO, but at a better bang for buck.

Western Digital's Black² is a unique take on the SSD/HDD duality.

"You ideally want to have a little of both: an SSD for the operating system and any applications you want to be fast, and an HDD for more general storage."

your programs, and heap of games all running superfast on the SSD. If you don't use your PC for much else, this may be all you need, and you can get away with not having an HDD in the system.

Alternatively, if space is more important than speed for you, the 2TB version of the Seagate Barracuda is only a little more than the 1TB model at around \$100. Mix and match to suit.

Another option to having an SSD and an HDD if you prefer to stick with a single drive is Seagate's SSHD hybrid drive, a traditional

HDD that has a little something extra with the addition of 8GB of flash memory, the type you find in an SSD. Some clever caching algorithms keep the most-used data in the SSD portion, providing substantially better performance for small-data workloads. A 1TB Seagate SSHD drive goes for around \$100, with \$150 for the 2TB version.

BEST MIDRANGE DRIVES

With a little more money to spend, aim for at least a 256GB SSD such as the aforementioned Sandisk Ultra Plus at \$130, or if you have a little

more cash to burn the Samsung 850 EVO is the premier SSD to have, though it clocks in at \$180 for the 250GB model. If you want to try for a pure SSD system and need more space, the 500GB of the 850 EVO hits \$320 which is starting to get pricey. However, you can get the previous generation 840 EVO 500GB for around \$280, which is a decent drop in price and performs just as well. For the same price you can also get the Crucial M100 512GB, which is another excellent choice.

When it comes to hard drives you can opt for the 2TB Seagate Barracuda at \$100, the 4TB model at around \$200 or go with Western Digital's classic performance Caviar Black series of drives. The 2TB model can be had for \$170 while the 4TB model goes for around \$300. Any of these will pair well with a 256GB SSD to ensure your system remains competitive for a number of years whilst giving you oodles of space to fill.

Alternatively, if you're keen on a single-drive solution, there's Western Digital's new Black² coming in at \$290 which pairs a 120GB SSD with a 1TB HDD, and does this in a single 2.5-inch package, meaning it can fit in a laptop as well as a desktop. To the PC it appears as two separate volumes, but due to its innovative nature has to be configured by Western Digital's own software before use. Performance wise either drive can't compete with the larger drives we recommend here, but it's a neat solution for a drop-in upgrade that will give you two drives for the space of one.

BEST PREMIUM DRIVES

Samsung has made a name for itself with SSDs, and the performance crown currently sits on the Samsung 850 Pro. The 256GB starts close to \$230, while the 512GB version makes your wallet cry at around \$430. If you laugh in the face of burning cash, the newly-minted 1TB model strikes home with a \$750 price tag. Bundled free come boasting rights and jealous looks from friends.

Another good contender is the Sandisk Extreme Pro (what is it with the Pro moniker?) with the 480G version a little cheaper than the Samsung at around \$370. It also has a giant 960GB model that sets you back a measly \$670, though can be had for as low as \$600 if you shop around.

With one, or two, of these drives (in RAID, if you wish) you may not need an HDD unless your vested interests include making a copy of Google, in which case the Caviar



New SSDs and hard drives for 2015

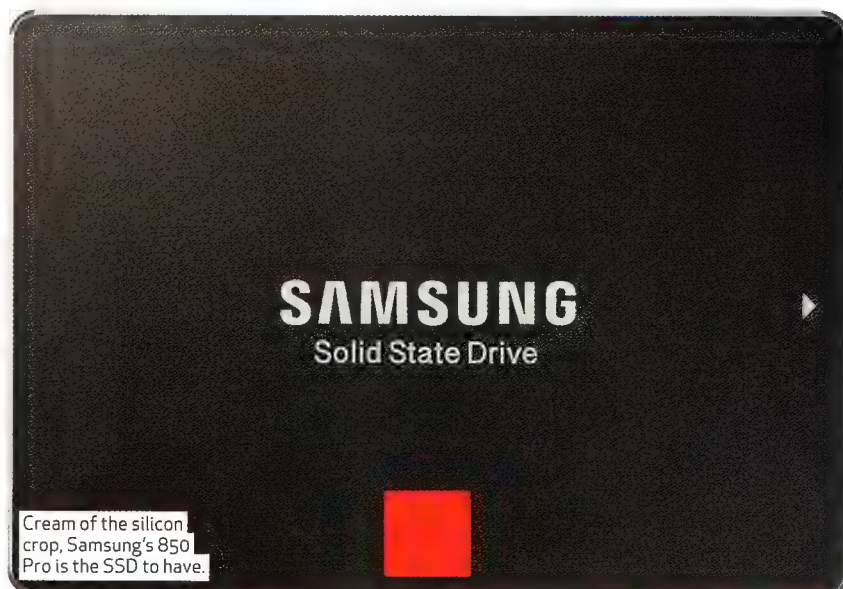
The storage advance continues and as massive as 8TB drives sound, they're just the stepping stone to 10TB which both Seagate and Hitachi (or more specifically HGST) have announced will arrive in 2015. While they will cost a pretty penny, this will push prices for down for smaller volume drives. Additionally, expect to see even greater densities making their way down to 2.5-inch laptop disks.

For SSDs there are already sizes available larger than 1TB, though apart from being obscenely expensive (over \$9,000 for Intel's 2TB DC P3700) they also plug in directly to the PCI-E bus. This is a precursor to the next standard for storage interface called NVMe (Non-Volatile Memory Express) set to replace AHCI (Advanced Host Controller Interface) that we use today, promising bandwidth speeds far in excess of that which SATA is capable. We won't see this reach the consumer space this year, but the march of progress will ensure prices for consumer SSDs continue to drop as well as a wider variety of larger drives hitting the market.

Black 2TB and 4TB models recommended in the Mid-range section — and which would pair beautifully with the above SSDs — might not be enough. Here then you might want to opt for Hitachi's 6TB Deskstar NAS 7200RPM beast which will set you back \$400, half the price and six times the size of Samsung's eye-watering 1TB SSD, which should help clarify why HDDs will be with us for some time to come. Western Digital also has a 6TB model in its Green series for about \$60 cheaper, but be

aware the Greens use a slower spindle speed and will perform quite a bit less.

If for some reason 6TB on a single drive is just too small for you (have you gone mad?!), Hitachi will also sell you the helium-filled Ultrastar HE8 8TB 7200RPM behemoth of incredulous size for a paltry \$1,100. Seagate also offers an 8TB model it calls the 'Archive' drive for around half the price of the Hitachi and a slower spindle speed, but can be hard to find. ■





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Add an SSD or hard drive

How to add more storage — or a new OS drive — to your PC. Dan Gardiner

These days, if you're installing a new drive the chances are that you'll be adding your new SSD or hard drive alongside your existing one/s — you can never have too much storage, after all — so that's the general assumption we've made with this guide. We're also guessing you'll be installing an SSD with the intent to use it as your OS drive. However, if you're just installing a new drive for storage, the hardware set up process is much the same — you can simply skip steps 5 through 7 and just boot up your PC, then in Windows, navigate to 'Control Panel > Administrative Tools > Computer Management'. Click 'Storage > Disk Management' and follow the prompts to initialise the new drive (you can use the defaults) then find your new disk from the list. In the big box to the right of the drive number, it should say 'XXXGB' and 'Unallocated'. Right-click this box, click 'New Simple Volume...' and again follow the prompts to format the drive and give it a name.

OTHER CONSIDERATIONS

When installing a new SSD, it's always best to reinstall your OS from scratch. This ensures the SSD gets formatted correctly and that important features, such as TRIM, are enabled by default. While it is possible to migrate your existing OS install to a new drive, it's a bit more intricate than we have room to go into here — check out our online guide at apcmag.com/how-to-migrate-to-a-new-boot-ssd.htm for further details.

If you're installing an SSD and it's the first one in your PC, you may also need to switch your drive controller's mode from IDE to AHCI in the BIOS. (This

setting is usually found under a 'Hard drives' or 'Storage' area, depending on the brand of motherboard.) AHCI is required to make sure all the features of your SSD are enabled. Note that enabling AHCI can stop existing Windows installations from being able to boot, as they won't have the necessary Windows storage drivers enabled. So before you change anything in the BIOS, head to support.microsoft.com/kb/922976 and follow the instructions to turn Windows AHCI drivers on for your current set up.

WHAT YOU'LL NEED

Apart from the new drive, you'll also need these items:

- A SATA data cable. Drives don't typically ship with these, but you should be able to find one in your motherboard box.
- A spare SATA power plug. This shouldn't be too tricky, as the SATA power cables coming from your PC's power supply (PSU) often have three or four plugs on a single cable — in other words, check the cable that's plugged into your existing drive/s to see if there's a spare. If there are no extras on that cable, check for any others coming from your PSU. If your PC has a modular power supply with removable cables, you may need to dig another SATA power cable out of your PSU box and plug it into the appropriate socket on the PSU.
- An OS install DVD or USB drive, plus activation key. If your new drive is going to house your operating system, we recommend reinstalling your OS from scratch.

As always, use an antistatic wrist strap when installing any new computer hardware to ensure you don't blow anything up.

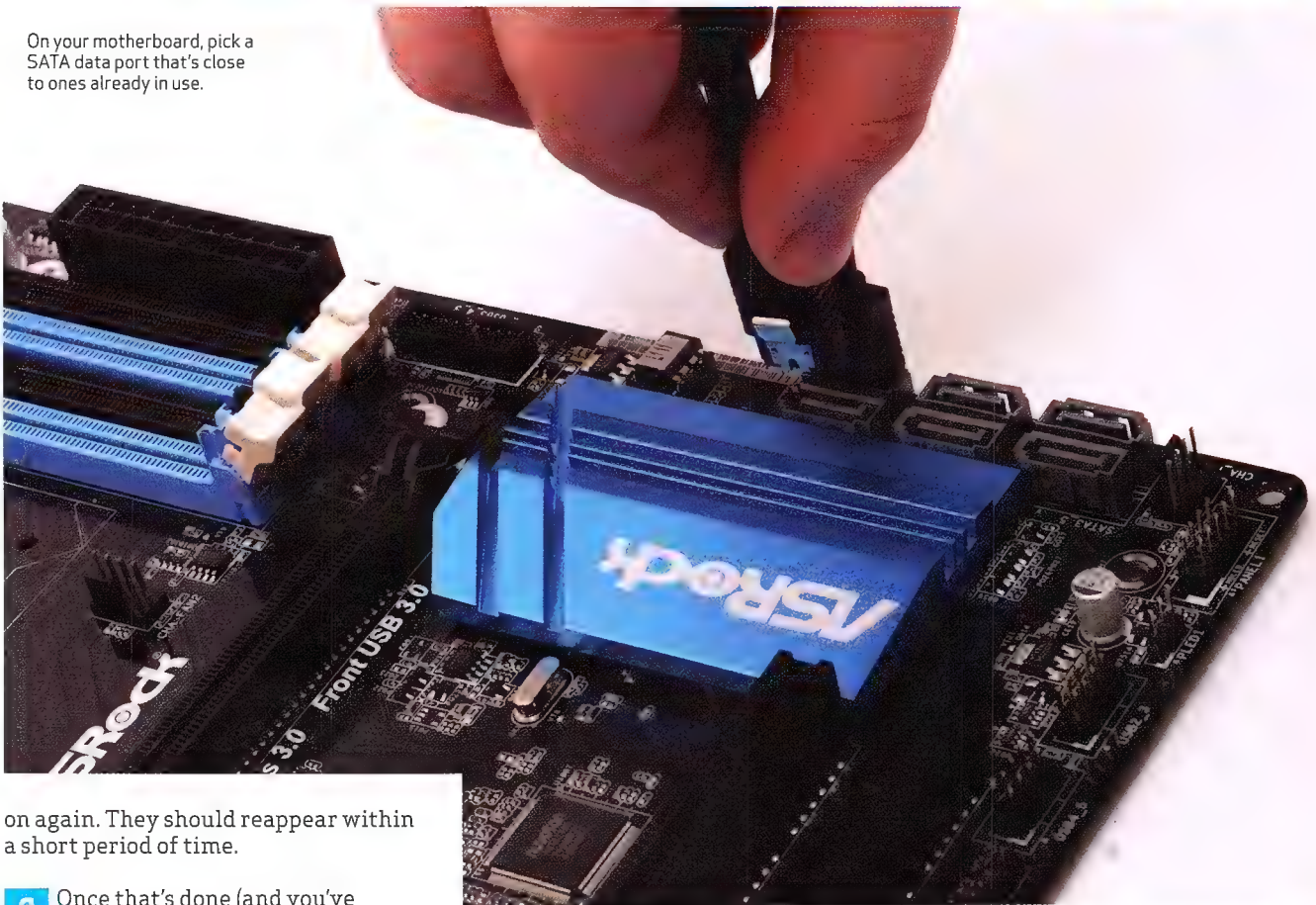
ADD A NEW SSD OR HARD DRIVE TO YOUR PC

- 1** Power off your PC, then unplug the power cord and any peripherals. Lay your case flat on a table and unscrew and remove the side (or top) so you can see its guts. Now, remove a free drive tray from the case — we'd recommend finding one near your current drives, as this should allow any spare SATA power cables to reach your new drive.
- 2** Take your new drive and screw it into the tray. Where the screws go will differ depending on if this is a 2.5-inch SSD (usually bottom screws) or a 3.5-inch hard drive (side screws). Once the screws are in, slide the tray back into place in your case and, if appropriate, screw the tray back in too.
- 3** Take your new SATA data cable and plug it into a spare port on your board — we'd recommend using one that's next to where an existing drive is plugged in. A quick note that it can sometimes be tricky to get to SATA ports on your motherboard if you have a large graphics card, as the latter can often cover them. You might need to temporarily remove your graphics card, in some cases.
- 4** Attach a SATA power plug to the drive.
- 5** A quick aside here: If you're installing an OS to this new drive from scratch, we'd suggest temporarily unplugging your other hard drives to avoid any confusion during set up. Just unplug the SATA data cable from your other drives, then, once you've completed the OS install, switch off your PC, plug them back in and power

"When installing a new SSD, it's always best to reinstall your OS from scratch. This ensures the SSD gets formatted correctly and that important features, such as TRIM, are enabled by default."

Most PC cases have removable trays that make drive installation easy. Just screw your hard drive or SSD in place, then slide the tray back in.

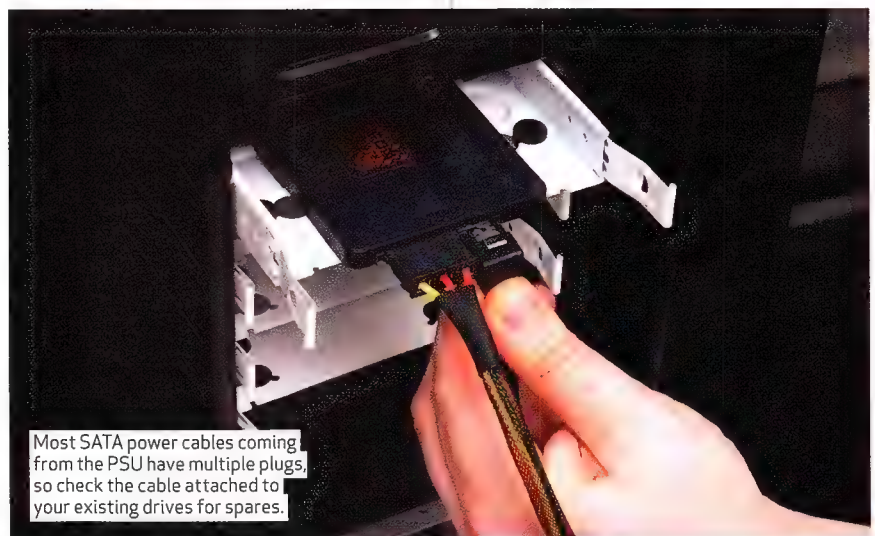
On your motherboard, pick a SATA data port that's close to ones already in use.



on again. They should reappear within a short period of time.

6 Once that's done (and you've re-plugged in any other hard drives you may have) we'll need to set the boot. Power on your PC and enter BIOS setup – on most motherboards, pressing the Del key will get you there. Now, different brands of motherboard put the boot order setting in different places – often its found under a 'Hard drives' menu, but hunt around until you find it. Set the boot sequence so that your new OS drive comes first, followed by any others.

7 Head back to the main BIOS page, save your settings and then exit. Your PC should boot up with your new drive! ■



Most SATA power cables coming from the PSU have multiple plugs, so check the cable attached to your existing drives for spares.

Upgrade your game

Installing a new graphics card is the best way to get better gaming framerates. Lindsay Handmer digs up the best current options.

The quest for the best graphics for your dollar is more complex than it appears, with a huge number of models available at different price points. It's also important to consider your system — there is no point opting for a whizz bang GPU that will be bottlenecked by your CPU or won't be able to run from your PSU. If your underlying PC platform is more than about three years old, a high end GPU will give very limited returns. Instead, aim for a lower end model or pick up an older higher end videocard second hand. If you have a newer computer that is struggling with the latest games, a new GPU can give a really big improvement for not a lot of money. If you already have a higher end GPU from the last generation or so, opting for an upgrade may leave you disappointed with not much more than incremental gains. It's always worth considering selling your older hardware, helping make each upgrade more affordable. Running multiple GPUs in CrossFire and SLI can give you bleeding edge performance, but at the lower end of the market it very rarely offers better bang for buck than a single GPU. Generally support is not as good and you are more likely to experience errors and inconsistent frame rates.

A very important consideration for GPU upgrades is 4K gaming. High resolution monitors are becoming more affordable and will only become more

The Radeon R9 280 is the current best buy under \$250.

so, making 4K gaming a real drawcard. Most of your existing games can already handle the resolutions, so it's an easy way to breathe new life into your favourite titles. The problem with 4K is that you will need a beefy

graphics card as well as a powerful overall system. Almost all modern GPUs can handle multiple monitors, but double check they have the connectors you need.

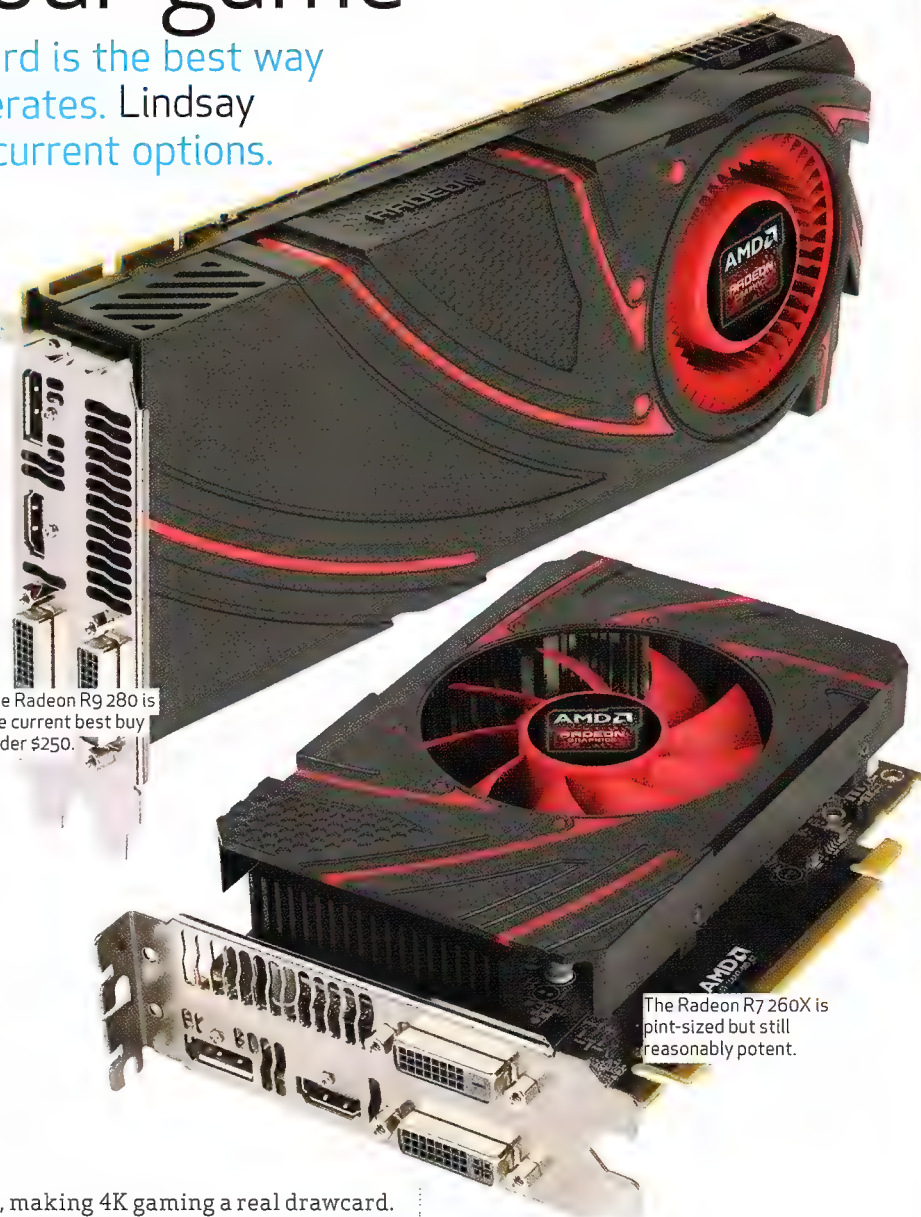
The graphics cards of 2015

We said it before but we will say it again — 4K gaming is the future. It didn't really make much of a splash in 2014, but as of 2015 a whole host of new monitors have been launched that support the resolution.

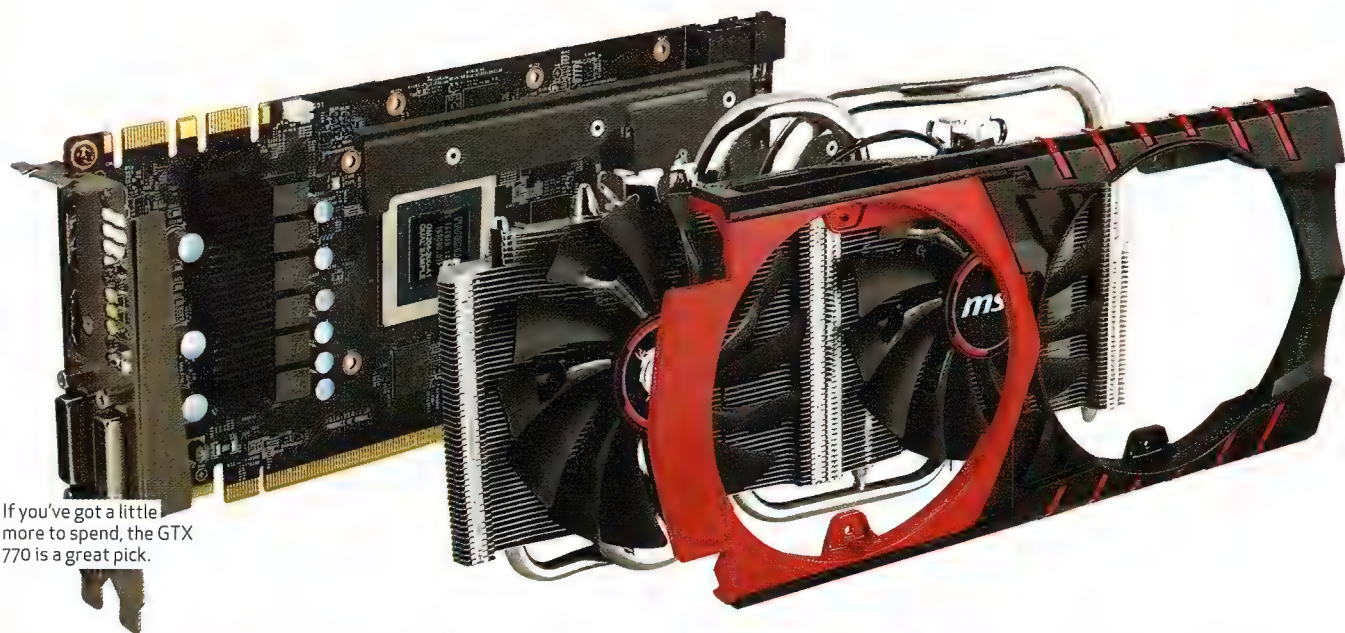
Nvidia has kicked off 2015 by launching new mobile GPUs, the GTX 965M, 970M and 980M. It's rumoured they will be announcing the new desktop mid-range GTX 960 early in the year but it's likely we won't see many big announcements till 2016. Nvidia continues to support G-Sync on a wider range of monitors. AMD is focused on 4K and the R9 graphics family, with support for Ultra HD laptop gaming using the Radeon R9 M295X GPU. You can also expect a wider range of monitors support AMD FreeSync technology. AMD has also announced new high performance system on a chip offerings as part of their ongoing mobile APU development.

THE SWEET SPOT

Fortunately for those on a budget, the sweet spot for GPU performance is on the more affordable end. For example, the Radeon 280 is an excellent bang for buck GPU and our clear favourite. For comparison, dropping back to the cheaper Radeon 260X saves you 40% of the cost, but you end up with about half the performance. If you spend twice what the 280 costs, you can expect only about 50% extra performance. To get double the performance of your budget GPU, you need to spend 3 to 4 times as much. Dual GPUs doesn't always change the sweet spot equation either



The Radeon R7 260X is pint-sized but still reasonably potent.



If you've got a little more to spend, the GTX 770 is a great pick.

— you tend to spend twice as much but don't get double the performance.

RECOMMENDATIONS

When buying a GPU, different brands do make a difference. Many offer overclocked models that can give a little extra performance or feature bundled extras such as games. While many manufacturers use the Nvidia reference design, others make a range of changes. In particular look for upgraded heat sinks and fans that will help your card run quieter and cooler. It's generally best not to opt for the very cheapest model as paying a little extra for a bigger brand will give a better warranty and more scope for extras such as factory overclocking. If you are after something even cheaper than our budget GPU, the Radeon R7 260X is a solid buy for under \$150.

**BEST BUDGET GPU:
AMD RADEON R9 280, \$250**

Released in early 2014 and finding a

home in countless gaming computers, the R9 280 gives surprisingly big bang for buck. While it can handle 4K if you make a few sacrifices, it will struggle at the higher detail levels. The dual-slot R9 280 supports DirectX 12, PCIe 3.0, up to six displays and can run in four-card CrossFire. You need both a six pin and 8 pin connector on your PSU as well as a rating of 500W or more. The Radeon R9 280 also comes in an X version, but it offers only a slight performance increase considering the extra cost.

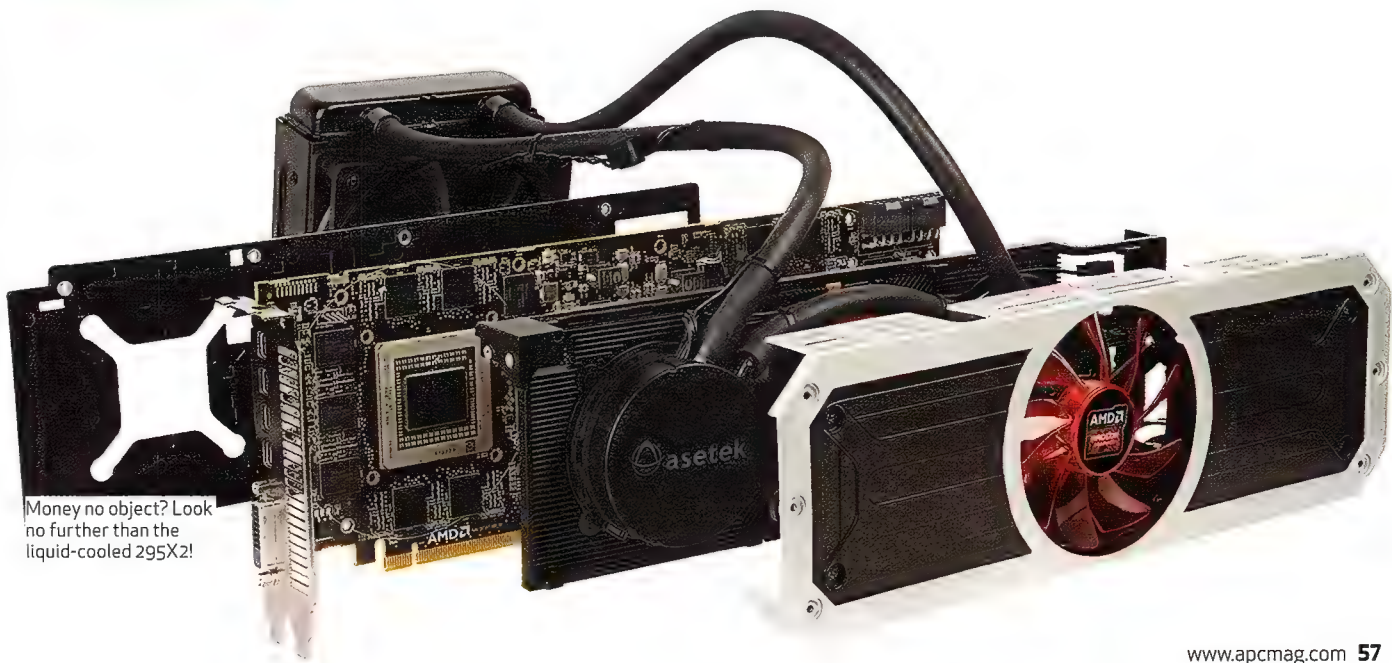
**BEST MIDRANGE GPU:
NVIDIA GEFORCE GTX 970, \$500**

A step down from the flagship GTX 980, the 970 offers only slightly less performance for a big reduction in cost. Its biggest competitor is the Radeon R9 290X (which can have the edge for 4K gaming), but ultimately the GTX 970 is the overall winner. It does offer reasonable overclocking performance, which can be a good way to eke out a

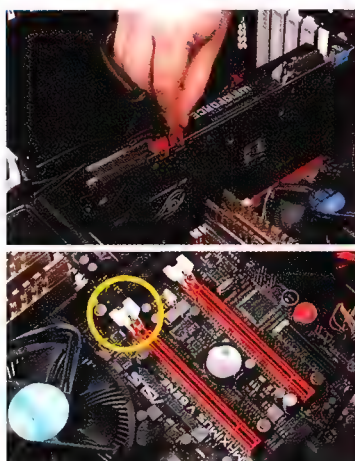
little more speed. The dual slot GTX 970 supports Nvidia G-Sync, 4K resolutions and up to four displays. The Nvidia architecture is quite efficient, so the card only needs 145W and will operate on a 500W PSU using dual 6-pin connectors.

**BEST PREMIUM GPU:
AMD RADEON R9 295X2, \$1,100**

For ultimate performance you can't go past the Radeon R9 295X2. It's expensive, it's giant and it uses a water cooling system just to avoid catching fire. But if you want the very fastest frame rates for 4K gaming, the 295X2 is your card. It's essentially two Radeon R9 290X cores squeezed onto one huge PCB and running together in CrossFire. The dual card needs a hefty 500W of power just for itself, so for a high end PC a 1000w or higher PSU is needed. It also needs dual 8 pin power connectors. If you are a madman, you can even run dual 295X2s in CrossFire.



Money no object? Look no further than the liquid-cooled 295X2!



LEFT: Different graphics cards can use different combinations of PCIe power cables. Check what's required before installing your new card.

LEFT: Note the little locking mechanisms at the back of the PCIe sockets. You'll need to disengage these to remove your old graphics card.

Push down firmly and evenly when inserting your card into the motherboard PCIe slot.

Swap out your graphics card

Got a new GPU? Here's how to install it. Dan Gardiner

Installing a new graphics card is relatively straightforward – the only slightly tricky bit has to do with power cables. Specifically, it's a good idea to figure out if your PC's power supply (PSU) has the correct PCIe power cables before you swap cards. Graphics cards take two types of power cable – known as PCIe 6-pin or 8-pin. They can use just one of these, but most gaming-grade graphics cards require two, with the exact combination dependent on the card. For example, a graphics card can require a single 6-pin cable, two 6-pins or a 6-pin and an 8-pin.

CHECKING POWER REQUIREMENTS

So, unpack your new graphics card and check the power ports – these are located towards the back of the card, on the top or rear. Count the number of holes each socket has to figure out what exact power cables you need from your PSU.

Now, open up your PC's case and check what cables are plugged into your current graphics card. (Note that on many PSUs, PCIe power cables actually 6-pin and 8-pin plugs, with the extra two pins able to be shifted out of the way for 6-pin socket use.) If the plugs in your old card match your new one, you're good to go.

If not, you'll need to check your PSU for the correct ones. Trace the current PCIe cables back to the power supply, then look for any additional PCIe cables to find the appropriate ones. If your PSU is modular (ie. it has removable power cables) you may need to dig into its box to find the right cables, then plug these into the appropriate sockets on the PSU.

Once you've found the correct cables, route them neatly through the case,

using your current graphics card's cables as a guide.

GRAB THE DRIVERS

Before doing anything further with the hardware, now's a good time to download the appropriate graphics card drivers for your new card – for AMD cards head to support.amd.com, while for Nvidia devices go to www.nvidia.com/content/drivers. Once you've got these, you're good to go. As with all hardware installs, we recommend using an antistatic wrist strap to make sure you're grounded.

INSTALL A NEW GRAPHICS CARD

- 1 Unplug the mains power and peripherals, and place your PC case flat on a table. Take the side off the case, first removing any screws holding it into place.
- 2 If applicable, unplug the PCIe power cable (or cables) from your existing graphics card (there's a little clip that locks these into place) and then unscrew the rear-bracket screws that anchors the card to the PC case.
- 3 Now, where the graphics card plugs into the motherboard, find and release the clip lock at the back of the PCIe socket – this holds the card in place. There are a few types of these locks – some simply move sideways and need to be held open as you pull out the card, while others fold open and stay open until a new card is inserted, which is the type in our photos.
- 4 After you've undone the clip lock, carefully pull up to remove the card, then place it in a safe place – we'd recommend an antistatic bag if you have a spare.

5 Most gaming-grade graphics cards take up two expansion slots in a PC case's rear panel – check your new card to see if this is the case. If your old card was only taking up one slot, you may need to remove another slot cover to fit the new card in. Figure out the correct one to remove by checking against your new card (this will usually be to the left of the open one). In some PC cases, these slot covers just unscrew (like your graphics card), but occasionally they are part of the case and you'll need a flathead screwdriver to lever out.

6 Insert your new graphics card into the PCIe socket, lining up the rear of the card with the openings, and then push down gently but firmly until the PCIe slot's clip-lock engages. Screw the card into the rear bracket – note that this can require slightly shifting the card so that the screw holes line up properly.

7 Plug the appropriate PCIe power cables (as figured out in our intro) making sure the little clip has locked them into place.

8 Reassemble your case and plug your PC back into power and you're peripherals, then boot it up. In Windows Vista/7/8.1, open 'Programs and Features' and uninstall old graphics card drivers – you'll find these under AMD or Nvidia, respectively. Reboot.

9 Install the new graphics card drivers you downloaded earlier, reboot if prompted, and you're all done! ■

Getting the big picture

A monitor upgrade can radically change the way you interact with your PC. Lindsay Handmer looks at your options and asks if it's time to go 4K?

Monitors are so cheap these days that anything under 1080p and 23-inches is worth upgrading – if your original is still good, consider running dual monitors. Rapidly dropping prices on 4K monitors mean they'll be a viable mid-range upgrade fairly soon. Of course if you already have the high-end hardware needed for cutting edge 4K gaming, then a new monitor is a must have. Note that 4K may look great, but Windows and many programs don't yet scale very well – menus and buttons are too small.

Another recent game-oriented feature is frame synchronization. Especially at high frequencies and resolutions, differences in frame rates and refresh rates can cause tearing and stuttering during gameplay. Thanks to extra hardware built into some new monitors, it and your GPU can work together to give a super smooth gaming experience. While not a new technology, new versions have made their way into a much larger range of monitors.

When upgrading, also make sure you double check what outputs your GPU has, as well as the inputs on your monitor. While you can adapt between many plugs, there is nothing worse than

getting a shiny new monitor with HDMI and DisplayPort inputs, only to realise your older GPU only has DVI outputs.

THE SCREEN SWEET SPOT

Right now 23- to 24-inch monitors are the sweet spot for size vs price. While you can grab bargain basement TN panels, there's also a range of very affordable IPS screens. They're the perfect size for the average desk, are pretty much all 1,920 x 1,080 res and almost all have HDMI inputs.

RECOMMENDATIONS

For budget upgrades, monitors under 23-inches don't offer significant savings. The premium market on the other hand is whole different beast. Don't bother with anything under 4K, but depending on your use there are a lot of other options to consider. High end gamers want Ultra HD res, but care more about refresh rates than colour accuracy and can opt for TN panels. If your monitor is for professional use, a high colour gamut IPS screen is best. For 4K on a budget, you can't go wrong with the 28-inch Ultra HD AOC U2868PQ.

BEST BUDGET SCREEN: LG 23MP55HQ, \$170

Featuring a 23-inch AH-IPS panel, the LG has better image quality and viewing angles than a TN monitor, but is still a small step behind IPS. It has a full HD 1,920 x 1,080 res, a 16:9 contrast ratio and a 250cd/m² brightness. The dynamic contrast ratio is 5 million to 1 (but 1000:1 native) and you get a decent 5ms GTG response time. It also has a wide 178° viewing angle. You get HDMI and VGA inputs and the usual tilt-only stand. That's not a showstopper and this one offers great quality for the price.

BEST MIDRANGE SCREEN: ASUS MX279H, \$380

27-inch is where it's at for gaming, movie-watching and productivity. The ASUS has a 1,920 x 1,080 res, a 0.311mm pixel pitch and a 5ms GTG response time. The AH-IPS panel gives wide 178° viewing angles, accurate colours and an 8-million-to-1 dynamic contrast ratio. It includes dual HDMI inputs. If you want gamer centric features such as 3D or high refresh rates but mid-range pricing, you need to look at smaller monitors.



Best budget screen: LG.



Best mid-range screen: ASUS.



Best premium screen: Dell.

BEST PREMIUM SCREEN: DELL P2715Q ULTRA HD 4K, \$879

You can spend tens of thousands on a high end monitor, but on a more practical note, Dell makes some of the best high spec models that only partially blow the budget. This 27-inch Dell sports an Ultra HD (3,840 x 2,160) resolution, a 350cd/m² and a 2-million-to-1 dynamic contrast ratio. The IPS panel has wide 178° viewing angles and a reasonably fast 6ms GTG response time. You get a boatload of inputs – DisplayPort, HDMI, MHL and USB 3.0. The Dell has an excellent fully adjustable stand as well as software for colour matching. ■

The year ahead for PC monitors

AMD FreeSync and Nvidia's G-Sync promise to give buttery smooth, tear-free gaming, but in 2015, last year's high refresh rates and 3D screens are set to take a back seat to 4K gaming. Ultra HD monitors are rapidly dropping in price and the high-res screens look set to be included in everything from laptops to tablets and phones. While increasingly-popular in TVs, curved screens are not likely to make much of an impact on monitors, though some options are filtering through. Ultra wide screens with 21:9 aspect ratios in particular are picking up, letting you essentially have two monitors in one. 5K screens are also set to make an appearance – letting professionals edit 4K video natively while retaining room for an interface.

Tackling a motherboard upgrade

It's a brave person who upgrades their motherboard. Darren Yates explains how to best survive the ordeal.

A motherboard upgrade is the toughest of them all to pull off successfully – and by 'successful', we mean come out the other side with your wallet and sanity intact. The trick is knowing when to proceed with it and when to call it a day.

BUDGET FOR A NEW CPU

The reality is that if you're talking 'motherboard upgrade', you'll likely need to budget in a new CPU as well. Intel's current socket format is LGA1150 and there's little previous-gen LGA1155-anything left in the market, so unless you already have an LGA1150 CPU, count the cost of one of these also.

If you're upgrading an existing AMD board to AM3+, the situation is much brighter – new AM3+ boards should run older AM3/AM3+ CPUs, you'll just need to check BIOS support before you let rip.

WINDOWS COMPLAINTS?

The sticking point could well be your Windows install – and from multiple angles. First, if you're using a Windows 7 OEM install, these are usually tied to a motherboard and at the very least, swapping motherboards could trigger a license reactivation, which Microsoft may or may not permit. If you're replacing a blown board, chances are

good they'll allow it. Windows 8 OEM licensing appears far more flexible and you can move from one board to another as many times as you wish (tinyurl.com/dxx6m2z). If you're upgrading the board in a Windows XP build however, BSOD is the usual greeting and you should think about upgrading the OS to something newer anyway.

HOW OLD IS TOO OLD?

With all that in mind, this is the money question – since everything plugs into the motherboard, when does 'old' become 'too old'? My rule-of-thumb is if you find a change in motherboard also requires a change of anything beyond a CPU, stop. If you don't want to end up with that \$30,000 dishwasher, start from scratch and build it right the first time, rather than try to jury-rig something together. And that will happen with older systems – a new motherboard could need new RAM (why won't my DDR2 fit?), hard drive (SATA what?), PSU (why won't that plug go in?), optical drive (where's my IDE port?) and graphics card (you mean they stopped using AGP?).

The bonus with starting from scratch is you end up with two systems – depending on its age, the old one could still run as a printer or media server.



For \$140 online, Gigabyte's GA-H97-Gaming3 delivers plenty of features.

RECOMMENDATIONS: BUDGET BOARDS

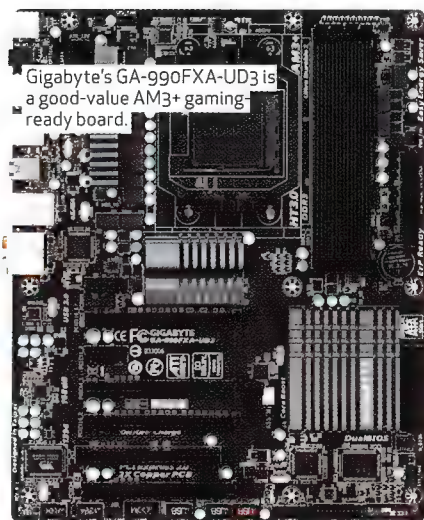
If the budget is tight, Intel's H81 chipset still delivers all your Haswell CPU speed. It just lacks extras such as RAID, multi-card gaming and more than two SATA 3 ports, but you can get boards like ASUS' H81M-E for under \$70.

If the budget spreads further, Gigabyte's GA-H97-Gaming3 loads up on everything the H81 lacks for around the \$140 mark.

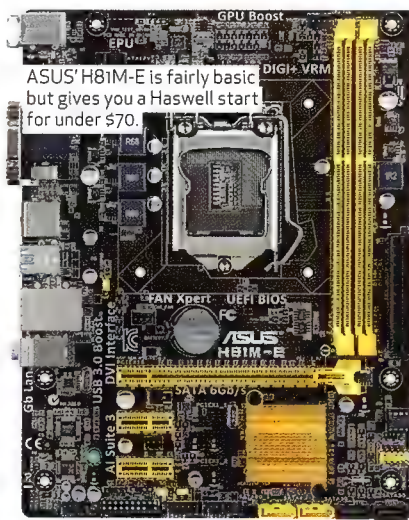
RECOMMENDATIONS: PREMIUM BOARDS

If you're rebuilding a performance box, it makes sense to go straight to a Z97-chipset board. Gigabyte's \$190 GA-Z97X-Gaming 3 includes SLI/Crossfire dual-card support, 10Gbps SATA Express and old-school tech like a PCI slot, useful in an upgrade.

For AMD systems, Gigabyte's GA-990FXA-UD3 Rev 4.0 for \$199 gives you SLI/Crossfire, SATA3, USB3.0 and will run any AM3+ CPU with interest. ■



Gigabyte's GA-990FXA-UD3 is a good-value AM3+ gaming-ready board.



ASUS' H81M-E is fairly basic but gives you a Haswell start for under \$70.

What's new in 2015

We have the Series-9 boards, but no Broadwell CPUs! But after its initial delay, Broadwell will be followed up quite closely with its successor, Skylake, most likely towards the end of the year with a new Series-100 chipset range of boards and a new LGA1151 socket.

Piling on the power

A quality power supply unit isn't just good for your PC, it's vital for performance components. Darren Yates explains.

The power supply unit (PSU) is usually the only component you don't notice until it stops working. But it pays to ensure you get such a critical component right, not just in having sufficient capacity for the job, but also in build quality to give a decent life.

It wasn't long ago that serious dual-card SLI/Crossfire system builds were looking for PSUs well over one-kilowatt (1000-watt) in capacity. But smaller transistors have enabled CPU/GPU manufacturers to improve performance and reduce power consumption at the same time, allowing us to mostly leave 1kW-plus PSUs behind.

GREENER GAMING

Intel CPUs have dropped TDP (thermal design power) peaks in recent years – down from 95-watts in 2010/11 to 77-watts in 2012 and 84-watts in 2013/14. AMD has similarly dropped from 130-watts peaks to the 95-watts of its top-drawer A10-series APUs. With smaller, even more efficient 14-nanometre transistors gracing Broadwell cores this year, it's unlikely we'll see Intel TDPs go back above 95-watts any time soon.

These smaller transistors are also improving GPU efficiency – Nvidia's new GeForce GTX 980 has a PSU recommendation of just 500-watts. The previous-generation GTX 780 rating was 600-watts. AMD's Radeon series has similarly dropped, although not to the same level.



Antec's 750-watt EDGE 80Plus Gold PSU, built by Seasonic and under \$200.

WHEN TO UPGRADE

The rule of thumb is whenever you upgrade your graphics card(s), check your PSU. This just means checking its power capacity against the GPU manufacturer's recommended spec – if your PSU is that or more, great. If not, upgrade to minimum spec. That said, I always like to exceed minimum spec by just a bit to give the PSU a little headroom – if the minimum spec is 500-watts, 550-watts is fine; a 600-watt PSU will give you plenty of spare capacity. If you're planning to game with a budget 'no-name' PSU (which we don't recommend incidentally), try to exceed the minimum power spec by 50% – and cross your fingers.

For multi-card SLI/Crossfire gaming with current-gen cards, we recommended you add to the GPU's minimum PSU power recommendation:

- 150-watts for each extra 'entry-level' card,
- 200-watts for each extra mid-range, and
- 250 to 300-watts for each extra top-drawer single-GPU card.

KNOW WHO BUILT IT

But here's our top tip – worry about who made your PSU, not the name on the box. Seasonic is the bee's knees when it comes to PSUs and about as bullet-proof as they come. Seasonic also OEMs for brands such as Antec, Corsair, XFX and usually at lower prices. Alternative OEMs worth looking for are Delta Electronics and Enhance Electronics, known for their



The High Current Gamer HCG-620M is another Seasonic designed PSU.



For non-gaming builds, Antec's Neo Eco 450W will last for yonks.

decent build quality too. Check often as brands will change OEMs for different models.

RECOMMENDATIONS: BUDGET (450W)

For light-gaming builds, go Antec's 450-watt Neo Eco 80Plus Bronze. It's based on Seasonic's popular S12II PSU and for around \$70 online, there's no need to cop a no-name cheapie.

RECOMMENDATIONS: MID-RANGE (600W)

Top-drawer single-card gaming rigs can use Antec's High Current Gamer HCG-620M (make sure it's the 'M' model). It's not new, but based on Seasonic's M12II-620 design, so this \$125-online 620-watt unit should be teak-tough.

RECOMMENDATIONS: HIGH-PERFORMANCE (750-800W)

Antec's EDGE 750W 80Plus Gold PSU is a new quiet design based on Seasonic's G-series. With 750-watts to play with, this \$170-online modular PSU will handle two GTX 980 cards nicely. ■

What's new in 2015

The latest ATX PSU spec has been around since 2008 but at this stage, there's nothing on the horizon by way of significant changes.

Casing the joint

Mid-tower bargain cases still abound, but there are many designs easier on the eye. Darren Yates reveals what to look for in a new PC case.

By the time you're thinking about the case, chances are you're considering upgrading everything else as well.

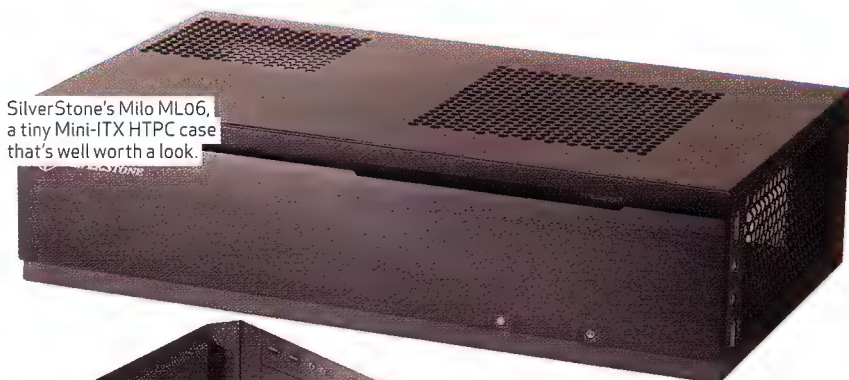
Nevertheless, the days of being stuck with beige towers are long gone, with striking designs available in all shapes, sizes and colours. You may well be limited in choice by your existing components, but there are many space-efficient cases that can shrink larger builds down to size.

PINT-SIZE ULTRA-COMPACTS

Mini-ITX boards continue to arrive at a decent clip, making it possible to build powerful, yet compact and even surprisingly quiet systems. We've been fans of BitFenix's Prodigy for a while, giving mini-ITX boards 'big PC' feel in a compact space. It still sells for \$99 online and it's one of the more quietly stylish cases we've seen this side of \$100. The thing that impresses is its ability to handle larger top-heavy air coolers — since the motherboard sits horizontally, the cooler creates much less strain on the board.

But even if you're working with one of the more compact microATX boards, you might be surprised by what's on offer. It's probably not everyone's cup of Earl Grey, but I have to admit I love the 1950s retro style of the DeepCool Steam Castle — you'll find it also for \$99 online. It comes in four different colours (surely it has to be fire-engine-red?) and it's large enough to handle a standard ATX PSU, mATX board and large-size graphics card. If nothing else, it certainly isn't beige!

SilverStone's Milo ML06, a tiny Mini-ITX HTPC case that's well worth a look.



Corsair's Carbide 200R, a very decent versatile case under \$90.



tiny seven-litre Milo ML06 is around \$75 online and will fit most Mini-ITX boards and a Noctua NH-L9i air cooler (maybe even a single-fan NH-L12, depending on the board). You'll need 2.5-inch drives to maintain decent airflow and a slot-loading slimline Blu-ray drive. Count on needing a slimline SFX-grade PSU as well, although, if you go for a Gigabyte GA-H97TN board, you just need a 19V/150-watt notebook power brick provided you stick to a CPU with an 84-watt or lower TDP. Other Mini-ITX boards like the GA-H97N can use an internal SFX PSU.

GOING BEIGE BUDGET

However, the scariest options on the market are the no-name cases that include an equally no-name 500-watt PSU, all for under \$50. For don't-care throw-together PCs, they'll probably do but if you must go 'budget', at least consider a good-quality PSU to give your PC components half a chance (check out our PSU page for recommendations). As for cases at this end of the market, Cooler Master's N200 is decent for under \$60, but if you can afford another \$20 or so, Corsair's Carbide 200R would be our choice. ■

HOME THEATRE PC CASES

Building a performance HTPC inside something akin to a 2U (two-unit) home audio component-size case isn't easy, with the most pressing issues finding suitable low-profile PSUs and CPU coolers. The other issue is finding HTPC case suppliers! Fractal Design and SilverStone are your best bet — SilverStone has a couple under the \$100 mark if your budget is tight. The

BitFenix's Prodigy still delivers big PC feel to Mini-ITX builds for \$99.



We love the 50s retro style of the \$99 DeepCool Steam Castle.



What's new in 2015

Expect to see more compact mATX cases sans multiple 5.25-inch bays — optical drives are just about done and greater CPU integration means expansion cards are less needed. Mid-tower cases will survive because they're cheap to make, but Mini-ITX will continue to gain momentum.

Keeping your cool

Choosing a cooler is as much about noise reduction as thermal efficiency. Darren Yates explains your options.

Despite all the hype, there's no technical reason to look beyond the stock cooler supplied with your CPU in a bog-standard default-clocked PC – unless you're thinking of overclocking, reconfiguring a build into a quiet home theatre system or an ultra-compact mini-ITX box. That's when alternatives start to shine.

LIQUID COOLING

Water-cooling used to be considered only by serious geeks, but the advent of lower-cost all-in-one (AIO), 'closed loop' or 'sealed' liquid coolers has seen them hit mainstream. The benefit is lower-profile mounting since only the water block and not the main cooling unit sits directly above the CPU. That also reduces the strain on the motherboard, since there's far less weight anchored to it. AIO coolers also typically have universal mounting mechanisms supporting all recent CPU sockets.

But if you're expecting superior performance compared with air cooling, you might be disappointed. AIO liquid coolers perform well, but often not much better than good-quality air-coolers. Investigate custom water loop kits for more significant gains.

As for AIO coolers, coolant leaks and pump failures are rare but possible – leaks really shouldn't occur if you install things right, however, writing

with my electronics hat on, the idea of liquid near electricity, particularly in tower cases with bottom-mount PSUs, doesn't give me the warm fuzzies.

LOW NOISE HSFS

CPU liquid cooling works similarly to a car radiator – liquid may transfer the heat but those radiator fins still need air-cooling and that means fans. So far, tests seem to show liquid cooling fans are not actually the quietest going around – certainly not as quiet as something like Noctua's NH-L12. NZXT's massive Kraken X61 or Cooler Master's Seidon 240M might be exceptions, but in practice, you can drop the noise level of any fan by simply lowering its supply voltage – AIO liquid coolers need lower pump and fan voltages – but that also drops the cooling efficacy, whether air or liquid coolers. It's why low-noise, high-efficacy coolers are the holy grail.

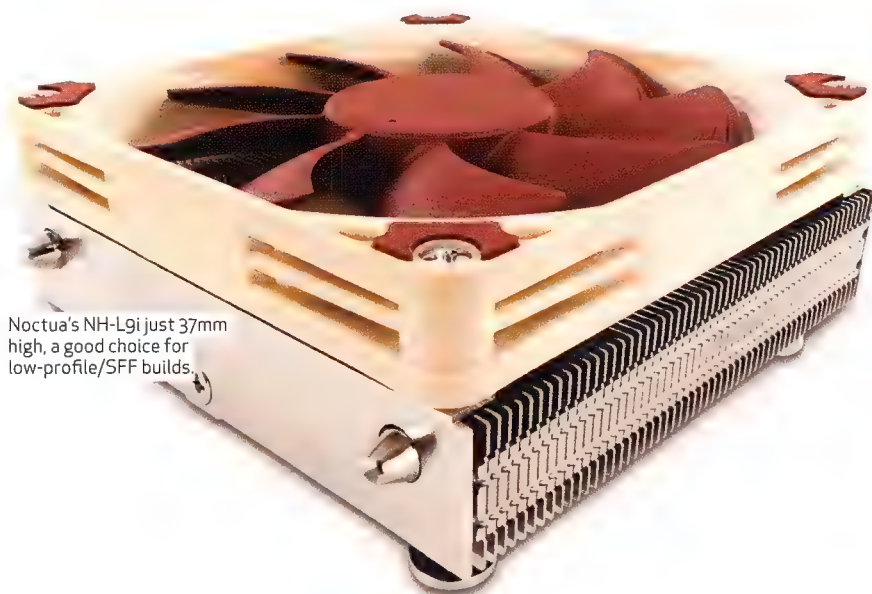
As for air coolers, they usually have two issues – size and weight. Larger coolers allow larger, slower-spinning fans to move more air with less noise. But their weight (Noctua's excellent NH-D15 weighs in at around 1.3kgs) makes it imperative that you use supplied mount backplates to prevent vertically-oriented motherboards from bending. If you run RAM with built-in heat-spreaders, clearance issues may also occur.



The NH-L12 from Noctua is one of the quietest air-coolers going around.

LOW PROFILE COOLERS

But things get trickier with low-profile/small form factor (SFF) cases where space is always at a premium. It's an issue often extending to mini-ITX motherboards – their compact dimensions often limit cooler size, simply due to the placement of the CPU socket or its proximity to other components. While you must do your homework and check that a cooler fits your board and case, Noctua's NH-L12 is still one of the best-performing and quietest lower-profile coolers going around and is our top pick. It's 93mm height with that second fan isn't that low-profile, but losing the second fan gets it back to 66mm at the cost of some cooling efficacy. Scythe's Shuriken Rev B comes in at 64mm and Noctua's NH-L9-series is just 37mm tall. But as usual, the lower the profile, the lower the cooling performance will be (so forget overclocking with a low-profile air cooler). ■



Noctua's NH-L9i just 37mm high, a good choice for low-profile/SFF builds.



NZXT's \$130-online Kraken X41 AIO liquid cooler – decent but not cheap.

What's new in 2015

The most significant changes in cooling tech may come courtesy of Intel's new LGA1151 socket rumoured to accompany Skylake CPUs late in 2015, which may have new cooler mounting dimensions. As for new innovations, there's nothing on the horizon at the moment.

TOTAL
PRICE: \$2,460

The perfect PC

Want to build an entirely new PC? Here's what we'd use.

We've given all our top picks for each category, but what if you're building a system from scratch? If that's you, we've put together a system, based on the previous advice in this feature, to make building a new PC a cinch. This isn't quite our top-drawer (aka 'money is no object') premium system, but it's a

very solid all-rounder with heaps of storage, fast CPU and GPU, full-featured motherboard and a nice reliable power supply.

If you're buying the whole thing at once, it'll set you back a cool \$2,500 — although if you have existing parts you're willing to continue using, that can cut the overall cost drastically.

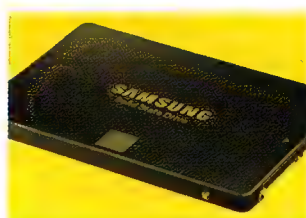
Just the storage and monitor, for example, make up around \$1,000. If you're happy to migrate your Windows install to this new system, that's another \$120, and you could certainly skip the custom cooler and just use the stock Intel one to save yourself \$90. With those money-saving options in mind, here's the system we'd build right now:



PROCESSOR: INTEL CORE i5-4690

\$270 | WWW.INTEL.COM

Delivers most of the performance of an i7-4790 at over \$100 less. If you want to overclock, go for the 4690K for an extra \$30.



SSD: SAMSUNG 850 EVO 500GB

\$320 | WWW.SAMSUNG.COM

Speedy and spacious SSD storage at a nice price.



MOTHERBOARD: GIGABYTE GA-Z97X-GAMING 3

\$190 | WWW.GIGABYTE.COM.AU

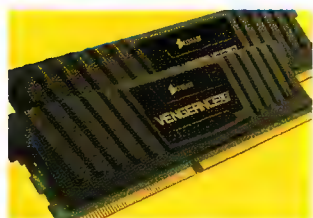
An excellent all-rounder board with all the latest features, giving you room to grow and upgrade in future.



HARD DRIVE: WESTERN DIGITAL CAVIAR BLACK 4TB

\$300 | WWW.WD.COM

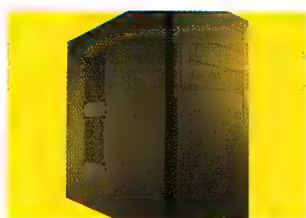
A solid secondary drive for media storage and other non-speed reliant tasks.



RAM: CORSAIR VENGEANCE LP 8GB (CML8GX3M2A1600C9)

\$115 | WWW.CORSAIR.COM

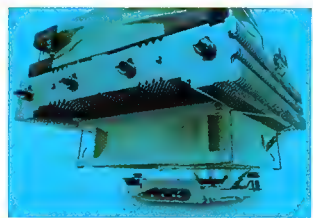
An affordably-priced 8GB kit (with two 4GB sticks) that's qualified for use in the above Gigabyte motherboard.



CASE: CORSAIR CARBIDE 200R

\$90 | WWW.CORSAIR.COM

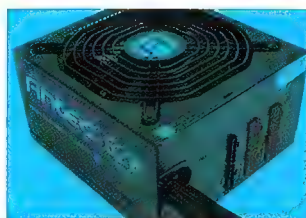
This stylish case is mostly tool-less and costs next to nothing.



CPU COOLER: NOCTUA NH-L12

\$90 | WWW.NOCTUA.AT

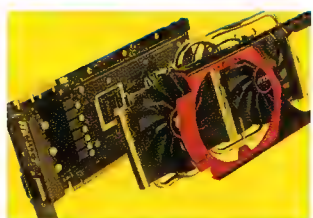
If you want a quiet and cool system, you can optionally add this custom air cooler.



POWER SUPPLY: ANTEC HCG-620M

\$125 | WWW.ANTEC.COM

Provides enough juice to run all the above components with a bit of room to spare.



GRAPHICS CARD: NVIDIA GEFORCE GTX 970

\$520 | WWW.NVIDIA.COM

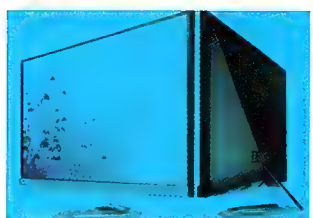
The sweet spot between performance and price. Go for a 4GB model, like the competitively-priced Gigabyte GA-N970G1 Gaming-4GD.



OS: WINDOWS 8.1 OR WINDOWS 7 HOME PREMIUM (OEM)

\$120 | WWW.MICROSOFT.COM

Choose between Windows 7 and 8.1, depending on your personal preference. ■



MONITOR: ASUS MX279H

\$320 | WWW.ASUS.COM/AU

It's only 1080p, but this big 27-inch screen offers good visuals at a great price.



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A more potent portable

Laptops don't have as many upgrade options as desktop PCs, but you can still rev up performance in a handful of areas, says Lindsay Handmer.

Laptops may seem simple compared to a desktop but there are a lot of factors to consider if you want to get good value for your upgrade dollar. Laptops generally cost more than a desktop, so prolonging its life is always welcome. The problem is that there are fewer upgrade options – some modern laptops are essentially sealed units with soldered in RAM, inaccessible HDDs and glued in batteries. Even for older units, there is no perfect upgrade solution or an obvious bottleneck that can be removed, leaving many upgrades offering dubious bang for buck. Installing an SSD is generally one of the best calls, but even that depends on what drive and hardware you currently have. The latest whizz bang SSD may be blazingly fast, but can be bogged down by a slow SATA interface. Installing 8GB of RAM may be super cheap, but your 32-bit copy of Windows won't actually be able to use it all. Often money is better spent upgrading your entire computing experience – get a second monitor, wireless mouse or a spare battery.

One very important (and free) way to boost performance is to clean your laptop heat sink – usually easily accessible by removing a few screws. Dust ingested by the fans can quickly clog fans and fins, which leads to overheated CPU throttling and severely hampered performance. Compressed air or a very careful vacuuming can get your laptop running like new again.

Laptop upgrades such as installing new RAM or swapping in an SSD are quite straightforward, but if in doubt there are countless guides available for free on YouTube. Before you go delving into your laptops innards, make sure you have a decent set of fine tipped screwdrivers and check if there is a step by step teardown guide for your specific model. Keep in mind that for an older laptop there may not be a best upgrade – you are simply better off looking to upgrade the entire thing.

EASY UPGRADES

For those without much experience or who have an older laptop, these are some of the easiest upgrades you can make yourself.



- Add more RAM. An especially worthwhile upgrade is running less than 2GB. Check exactly what RAM and configuration you have – it's usually easily accessible under your laptop. Don't bother upgrading if your RAM is very expensive.
- Add storage via the SD card slot. Most laptops have an SD card slot, making it a very easy way to add storage. It's not the fastest or the cheapest per GB, but installation is as simple as slotting it in. You can also use an SD card and Windows ReadyBoost to improve performance.
- Speedier Wi-Fi. Older laptops typically only support fairly slow Wi-Fi speeds. If you want to stream video or copy files over your network, a USB Wi-Fi stick is a simple

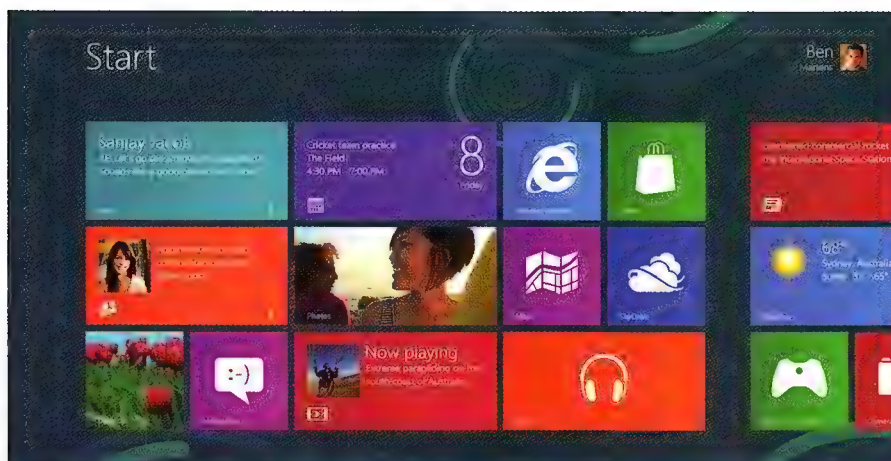
upgrade. Aim for at least 802.11n and look for large antennas for longer range.

- Enhance productivity with a second screen. With limited resolutions and panel sizes, a second screen can really boost the usability of a laptop. Double check your connectors to ensure compatibility. For maximum portability, get a USB connected (and powered) monitor.

INTERMEDIATE UPGRADES

It will take a little more skill, but you can get a surprising amount of extra performance from your existing laptop. Drop your old HDD into an external USB case to access your files.

- Swap the hard drive for an SSD. Bring the snap back to a sluggish PC as well as boost battery life. A cheaper last generation model SSD is slower but will still max out your older laptops bandwidth. Many newer laptops have M.2 SSD slots for easy upgrades.
- Or a hybrid drive. Need oodles of space but want SSD like performance? A hybrid drive can combine both. It won't be quite as fast as a standalone SSD, but can still speed up your laptop while retaining large amounts of storage space.
- Refresh your Windows install. After a few years, Windows starts to bog down and doing a complete re-install can bring your system back to like new speed. Consider Windows 8.1 – it's optimised for low end hardware

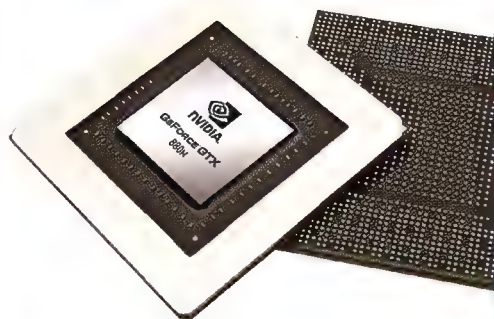


The laptops of 2015

Many of the larger gaming laptops or barebones models are very DIY friendly but the newer, cheap but slim models are becoming harder to upgrade. Many have soldered on RAM and SSDs, glued in batteries and no optical drive bays. On the plus side, new laptops are getting even cheaper considering the performance and surprisingly good yet ultra-cheap models under \$300 are available. In higher end models 4K screens are set to become more common, while cheaper laptops are moving towards 1080p as the standard resolution.

Some big gains have been made with super-efficient Intel CPUs that mean the latest generation of laptops can be very thin and light yet retain decent battery life. On the lower end, totally fanless laptops are available.

SSDs are almost standard now, but we can expect prices to continue to drop as newer, smaller and faster drives are released.



and can be faster than Windows 7.

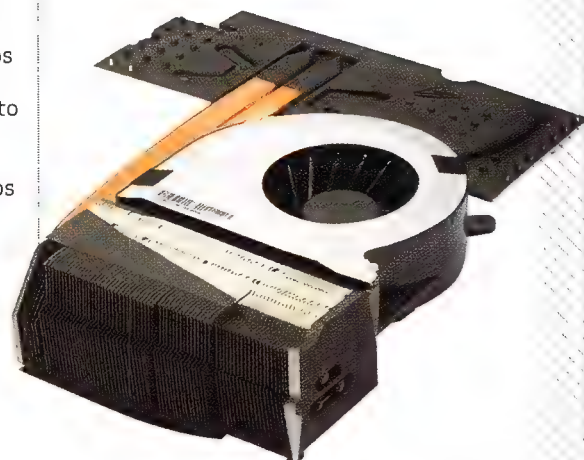
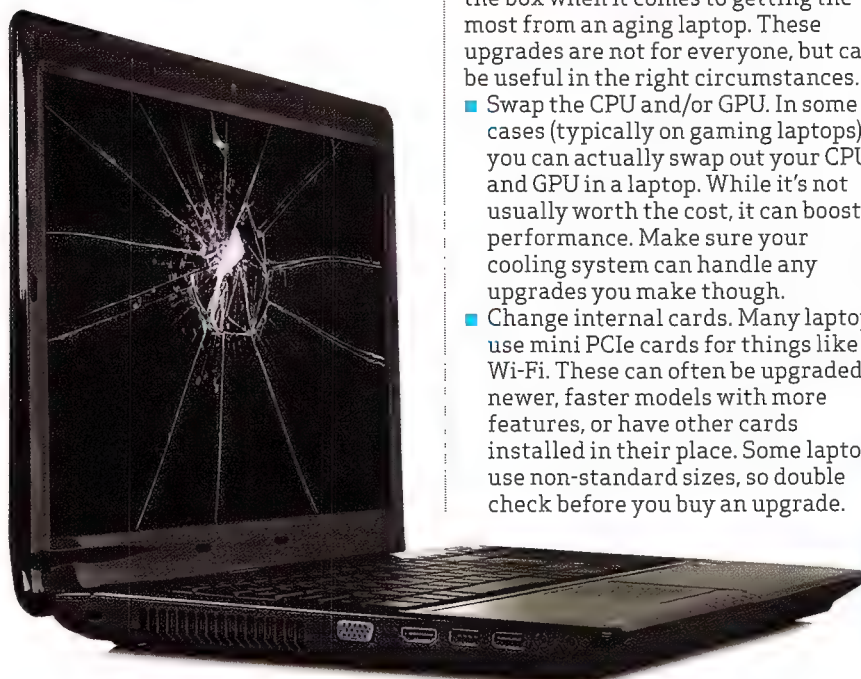
- Replace the optical drive. DVDs and CDs are not as commonly used these days so your optical drive bay can be put to better use. Depending on your laptop, you can slot in an SSD while retaining your original drive or even squeeze in an extra battery.

OTHER UPGRADES

Sometimes you need to think outside the box when it comes to getting the most from an aging laptop. These upgrades are not for everyone, but can be useful in the right circumstances.

- Swap the CPU and/or GPU. In some cases (typically on gaming laptops) you can actually swap out your CPU and GPU in a laptop. While it's not usually worth the cost, it can boost performance. Make sure your cooling system can handle any upgrades you make though.
- Change internal cards. Many laptops use mini PCIe cards for things like Wi-Fi. These can often be upgraded to newer, faster models with more features, or have other cards installed in their place. Some laptops use non-standard sizes, so double check before you buy an upgrade.

- Grab an aftermarket battery. Don't go for the cheapest battery on eBay as many are low quality. You can even get high capacity batteries that will give longer life than the original. You can also get external batteries that plug in via the charge port.
- Switch out the screen. While it's a rarer option, on some laptops it is possible to upgrade the screen. Many models are sold with more than one screen option and higher resolution panels (or aftermarket replacements) are easily installed.





Everything's cool

Understand your PC's thermodynamics to unlock its true power.

The first rule of thermodynamics is: you do not talk about thermodynamics.

The second rule of thermodynamics is: if you have a hardware problem, there's a good chance heat is to blame. Heat is the nemesis of pretty much everything you're trying to do with your system. Want to run your processor faster? Heat is holding you back. Speed up graphics? Heat will happily shut that door in your face. Pack more juicy components into your chassis? You'd better allow for good airflow or the whole lot will be brought to its knees gasping for air.

The ways we tackle heat production has evolved over the years. Original PCs didn't go in for all this active cooling malarkey. Indeed it wasn't too long ago (in human evolution terms at least) that your CPU would've needed to be something special to boast even a heatsink. As time has passed though, and processor designs developed, more aggressive cooling has been needed. And despite a few blips along the way, we now find ourselves at a point where an aftermarket cooler is pretty much expected — especially if you're looking to get the most from your processor.

We're not just talking about

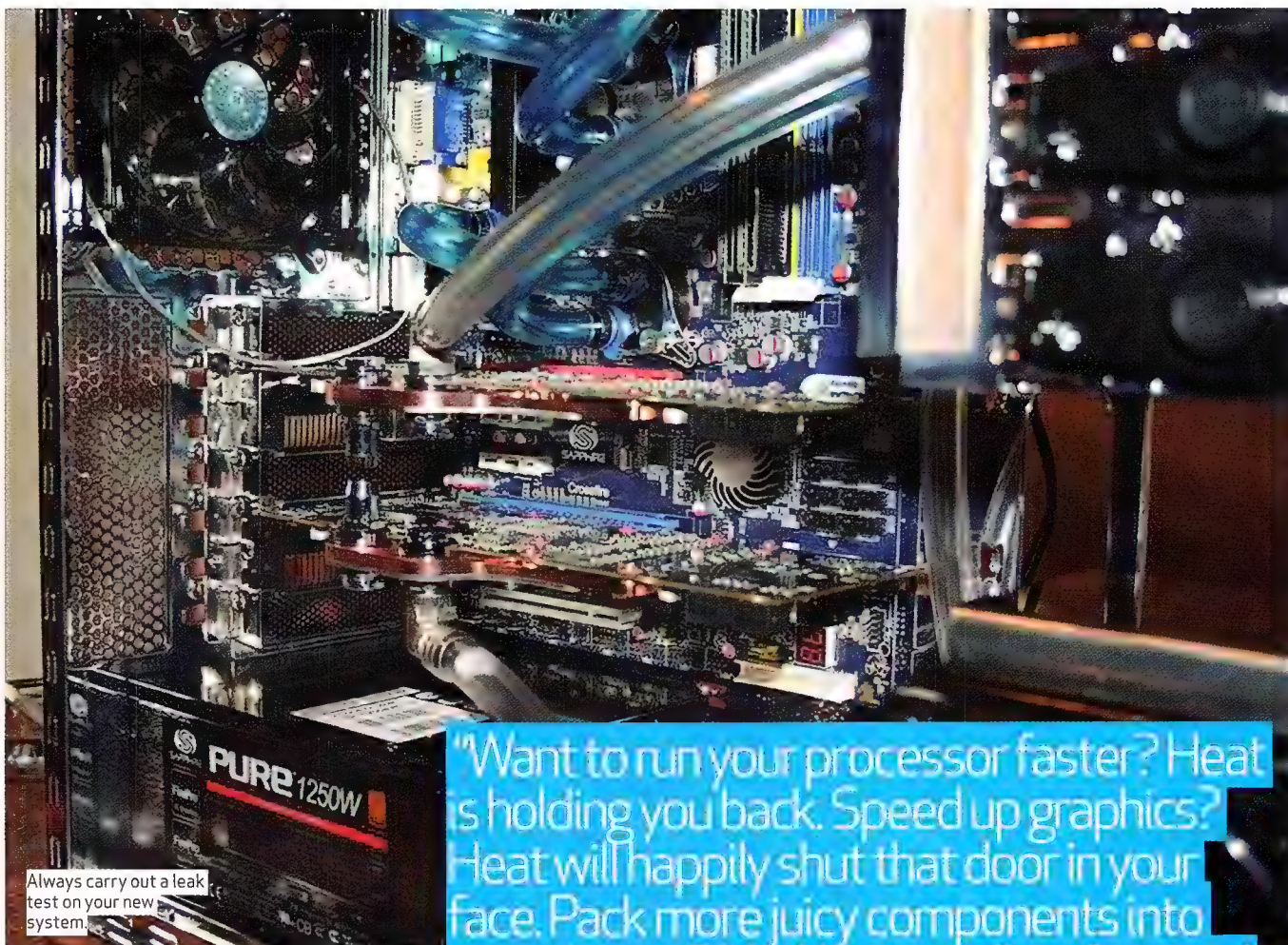
overclocking when we say that either, because as CPU designs have developed, so effective heat management has become essential. This in turn means that part of the silicon in the latest CPUs is there to monitor just how hot the chip is getting, and thus it can control the speed at which it is operating. This is the basis of Intel's Turbo mode. The Core i7-4770k for instance may have a base frequency of 3.5GHz, but if the chip is cool enough it can up the frequency to 3.9GHz on the fly. The trick therefore is to make sure it has that headroom available, and one of the best ways of doing that is to toss out the basic CPU cooler that came with your chip and replace it with a closed-loop water cooler.

Check out the specs sheets of your CPU, and you'll find reference to its TDP. Standing for thermal design power, it's an indication of how much heat a component produces when used. It may not be immediately obvious what the TDP is actually referring to, but it's not the peak wattage you can expect a given chip to run at. In fact, it's defined as the average power dissipation when running at the base frequency. So not at the turbo frequency even.

Rather than being the peak thermal power you need to allow for in a worst case scenario, the TDP of a processor is actually the thermal point that you're likely to see in normal day-to-day usage. This is a reason why TDP is sometimes referred to as the thermal design point. To give an example, the TDP for the Core i7-4770K is 85W, so in order to keep the chip running optimally, the chip's cooler has to be capable of shifting at least 85W of energy to compensate.

That this isn't the peak heat output is important — you can work out the thermodynamics of your system to a wonderful degree, only for the chip to overheat and bring your system to its knees when really thrashing it. Overcompensating on your cooling means your CPU won't be throttled, which in turn means you'll be getting the very best from it. Or, put another way, getting what you paid for. And the best way of overcompensating is to water cool your chip.

Water cooling has been held up as the pinnacle of cooling by the modding fraternity for years, but for many the hassle of setting up such a system outweighs the benefits. It's simply too much trouble for the vast majority, with the added fear of throwing water



Always carry out a leak test on your new system.

"Want to run your processor faster? Heat is holding you back. Speed up graphics? Heat will happily shut that door in your face. Pack more juicy components into your chassis? You'd better allow for good airflow or the whole lot will be brought to its knees gasping for air."

all over your motherboard. This is where closed-loop solutions ease into view and offer most of the benefits of a full water-cooling system, but in a much easier-to-swallow form.

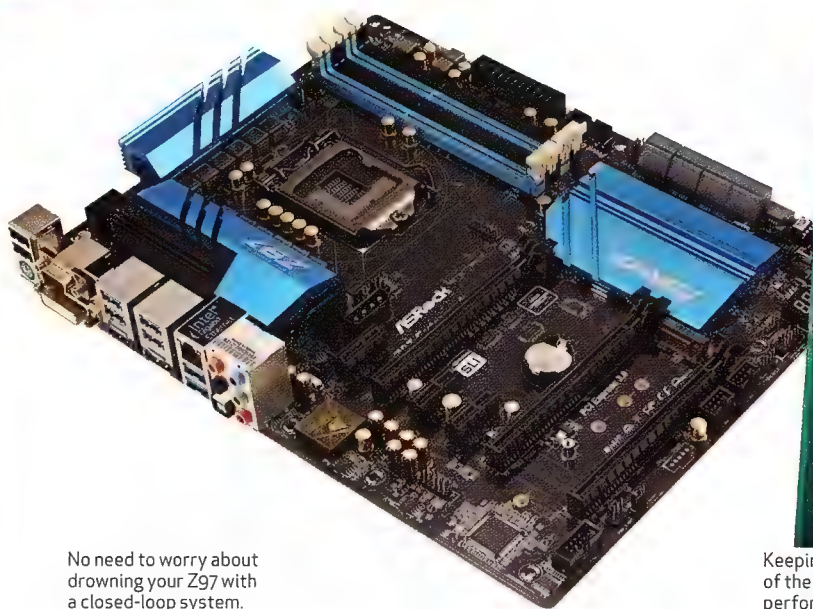
Compare the cooling afforded by a closed-loop water cooler with a decent air cooler and you'd be forgiven for thinking there wasn't a lot in it. Simply look at the operating temperatures at full load and then the differences can indeed be slight. However, that isn't the whole story. An important factor in these days of turbo mode is the time it takes to go from the high temperatures of full-load down to the idle temperature, and it's here that closed-loop water coolers really come into their own — as generally they'll drop back down to idle levels in seconds rather than minutes. And that means the CPU can turbo much sooner again.

COOL WATER

In a standard water-cooling system you have one or more water blocks in contact with the components you wish to cool. A flow of water is maintained through these blocks and the radiator that cools the water down again through the use of a water pump. In order to improve the efficiency of the radiator, one or two fans are used,



If space is an issue for you, try a 120mm cooler.



No need to worry about drowning your Z97 with a closed-loop system.



Keeping cool is the name of the game for CPU performance.

while a reservoir is also present to ensure that there's enough liquid in the system to keep things continually running smoothly.

All these elements are present in closed-loop systems too. The reservoir is often combined into the water block, while the water pump either sits in the radiator or in some cases on top of the water block. The specifics differ between products, with the number of fans ranging from one 120mm cooler all the way up to three fan systems. Two fan systems are quickly becoming the norm though, either on a 120mm-long radiator with a fan on each side, or a 240mm radiator with the fans next to each other.

Which one you go for is largely determined by how much money you have available to spend on cooling and

how much room you have in your case.

One thing to consider when making the move to a closed-loop water cooler is that it moves the main heat pump away from the centre of your rig. Depending on the air cooler that you're replacing and the layout of your case, this can either be a good or bad thing. It may mean that you have to add extra system cooling to ensure there's still a good airflow over your motherboard, and specifically over the power regulators that are behind the ATX connectors. Good airflow is also a good idea for your system storage of course. Going down the closed-loop water cooling route isn't going to solve all of your system-cooling needs with one unit, in other words.

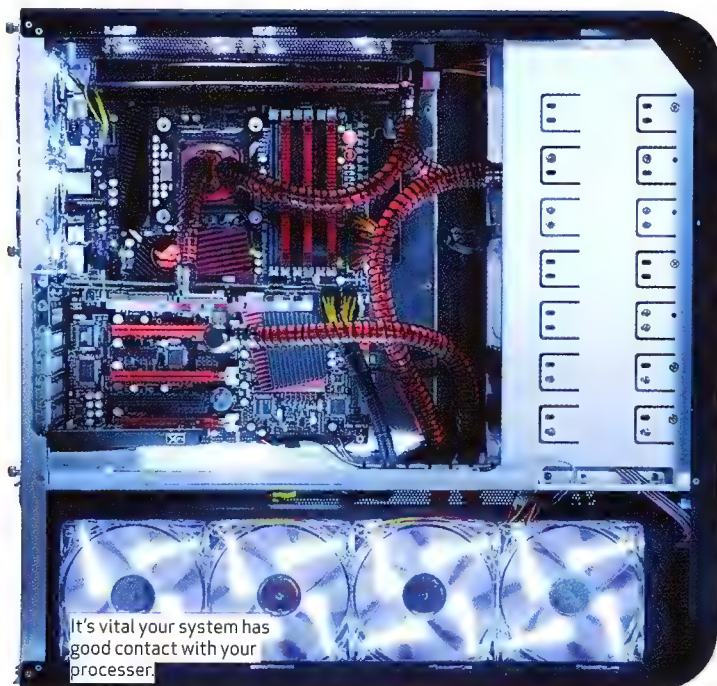
Closed-loop systems are gaining traction in other areas though.

You only have to look at AMD's R9 295X2 cards to see that closed-loop solutions aren't limited to just sorting out the heat generated by your processor. Indeed traditionally, water cooling configurations would often include water cooling for your graphics card, processor and in some cases the power circuitry of your motherboard as well.

And there's nothing to stop you going down the full system cooling route even today, of course, although for this month's group test we're limiting ourselves to the latest and greatest closed-loop systems for the sakes of clarity.

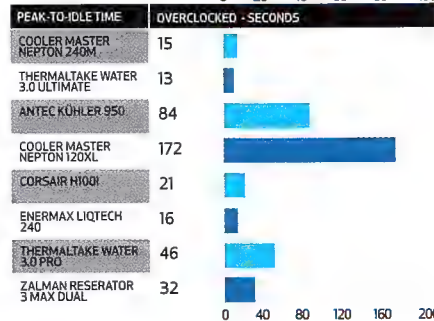
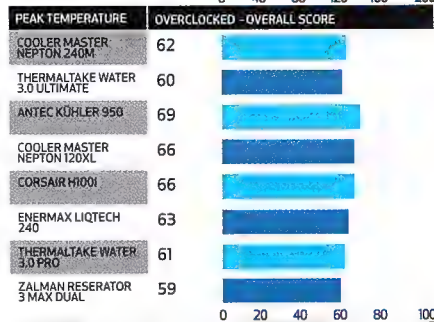
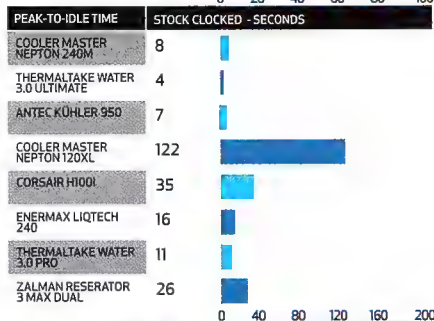
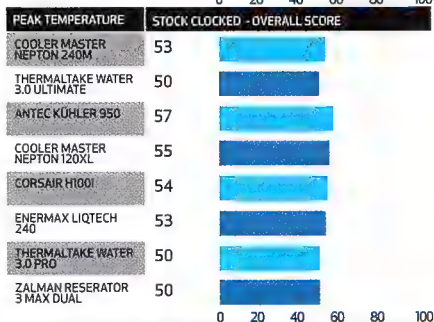
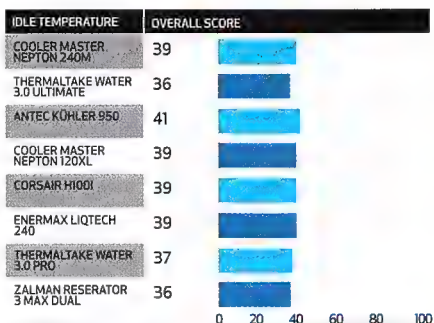


Your cooler size is largely dependent on your case size.



It's vital your system has good contact with your processor.

Testing water coolers is a necessarily time-consuming process. Fitting them alone can take upwards of 20 minutes from scratch and that's on an open test bench. To start with we test on a stock-clocked Core i7-4770K system, measuring first the idle temperatures with RealTemp, tested after around 10 minutes of up-time. Then we use a tool called MaxCPU to push the CPU to 100% load and leave it running for 20 minutes before we measure the peak temperatures. We then measure the time it takes for the temperature to drop from the peak to the idle temperature. Finally we go through the whole process again, this time overclocking the CPU to 4.5GHz.



INSTALLATION FUN AND GAMES

Installing CPU coolers is, we're pretty sure, one of the circles of Hell described in Dante's *Inferno* — as a chore to be carried out by telephone conmen who talk the elderly into installing viruses onto their PCs.

Either way it can be a real pain. Often literally. Most closed-loop coolers are every bit as tricky as awkward air coolers on this front — the good ones use easily accessible clips and thumb screws, while the worst offenders have you stripping the skin off your fingers to actually attach the main block on top of your precious CPU. Removing your motherboard from the case is often a requirement, even if said chassis has a cutout on the motherboard mounting. Accept that you're going to have to do this and get on with it is our only advice.

There is an added complication with closed-loop water coolers though, and that's the huge fan/heatsink combo you need to trail through your system and somehow attach to your case. If you've spent a good chunk of cash on your chassis then this may not be too much of a problem — but still check the measurements of the cooling array to make sure you have enough room; particularly if you're going for a 240mm, double-fan cooler. Even single-fan radiators can be tricky though, due to the thickness of the fan and radiator combined.

Again, make sure you've got enough room in your case before you buy one. Such coolers are usually installed in the top of the case, although single-fan 120mm can sometime squeeze in above the CPU socket on the rear. Make sure the water pipes aren't twisted between the CPU and the radiator, and don't forget to attach the pump power cables either — forgetting this is a great way of seeing just how quickly your CPU can hit maximum temperature, but it's rubbish for getting the most out of your CPU.



WATER COOLER

\$130 | WWW.ANTEC.COM

Antec Kühler H₂O 950

An oddly massive 120mm cooler

Quite what Antec has done with the latest Kühler range we're not entirely sure.

For reasons best known to itself, it's decided that having the water pump sitting atop the CPU itself is a problem. A problem that no-one else seems to have. As such the pump has been repositioned to protrude from the front of the main 120mm fan, which is firmly and irretrievably attached to the radiator.

When you attach the second 120mm fan on the opposite side of the radiator, in a push-me-pull-you configuration to increase airflow, the Kühler 950 becomes enormous. The radiator itself is already a chunky 49mm and, when you add on the size of the two fans and the weird pump proboscis poking out of the front, it becomes as deep as it is wide as it is high. That can make it a little bit awkward to squeeze inside the smaller chassis, and when you're working with a 120mm

radiator you'd almost always expect to be able to jam it in whatever case you're packing.

In terms of peak cooling performance, none of that extra girth helped the Kühler avoid being bottom of the class when in overall temperatures. But none of the coolers we've tested are necessarily bad, so even if its temps aren't the lowest they're certainly not going to leave your CPU roasting. And because of the depth of its radiator, and the twin fans, the peak-to-idle timing on a stock chip is stunning. It's also mighty cheap and very, very quiet. It's not the most effective cooler nor the simplest to fit, but the silent performance, low price and speed of cooling means it's still worth a look.

Verdict

Quiet operation; quick stock cooling; awkward fitting; highest temps on test; poor software; big.



WATER COOLER

\$119 | WWW.COOLERMASTER.COM

Cooler Master Nepton 120xl

Why to buy 240mm coolers.

The lesson today explains why you pick a 240mm radiator to fit to your overclocked CPU as opposed to a wee 120mm job. And to help us illustrate that point is the new Cooler Master Nepton series of chip chillers. We're also impressed with the Nepton 240m, but this 120xl version perfectly highlights the extra cooling performance you get from a larger radiator.

As we've said, none of the coolers on-test are bad, but the cooling performance of the 120xl is noticeably worse than the 240m. It's still cooler than the Antec, but the problem is the time it takes to return the CPU back to its idle temp after running at full pelt. Even at stock processor speeds the 120xl took over two minutes to get back to the idle temps. When the Nepton 240m, with effectively the same overall design, is able to deal with a stock-clocked 4770k in just eight seconds, you

can see how much difference that extra radiator space makes.

Elsewhere though the 120xl is very much like its larger sibling, from the simple and effective mounting mechanism to the fans themselves. The way the 120xl attaches to the chassis is well thought out too, with a fitting that's versatile enough to allow you to mount the secondary fan either inside or on the outside if there's no room.

That all means we end up with a cooler that's simple to fit, but might leave you wanting in the cooling stakes. Where the 240m sits at the top of the tree this smaller Nepton sits behind all the other 120mm coolers we've tested.

Verdict

Simple fitting; sturdy build; versatile; slow cooling performance; quite expensive.





WATER COOLER
\$139 | WWW.COOLERMASTER.COM

WATER COOLER
\$149 | WWW.CORSAIR.COM

Cooler Master Nepton 240M

Easy to use and quick to cool.

Cooler Master sure does know its CPU cooling tech. The previous Seidon range was one of our favourite closed-loop liquid chip chillers and the new Nepton lineup is most definitely built from the same cooling DNA. It uses an almost identical mounting setup as the latter, but ever-so-slightly more evolved, with a more manageable installation procedure that means you don't need a third hand.

While installation is an important factor, though, cooling performance trumps it. Thankfully the Nepton is also a mighty impressive chiller too. It's not the absolute coolest in our testing – the Zalman Reserator 3 Max Dual just about takes the honours with the lowest CPU temps – but Cooler Master is only just a little shy with this Nepton. Where it does win is in just how quickly it can return your CPU from peak to idle temperatures; just 15 seconds. The peak-to-idle

temperatures are so important because of the variable speeds of today's processors. When you've got CPUs switching from 800MHz all the way up to 4.5GHz, there's a huge amount of variation and your cooler really needs to be able to keep up.

And there's another reason why the Nepton takes the win in this test; it uses a 240mm radiator, so it will fit in most cases.

Upgrading your PC's cooling is not all about performance. Being able to get your new chip chiller to fit, and do it without requiring a complete rebuild, is arguably more valuable than a few less °C on average which you're never going to notice...

Verdict

Simple to fit; robust build; impressive cooling performance; a great all-rounder.



Corsair H100i

Old age doesn't have to be a barrier to cooling.

The biggest surprise isn't the fact the Corsair H100i is still a very competitive water cooler. It's the fact it's been around so long. The H100i demonstrates just how good corsair's original design was – it's barely had to change the design since it was released.

There have been updates, such as the H105 and H110, but we're still fans of the original's solid mounting bracket which made it so easy to switch chips around. Before we had the Cooler Master Seidon chilling our test rig the Corsair H100i had that responsibility. It's simple, elegant design is matched by the software support too – the link tech allows different corsair peripherals and components to talk to each other. It allows you to manage the cooling throughout your system and you could easily lose days to testing and tweaking the different settings to deal with hotspots. Sadly though the stock performance isn't as

competitive as it once was compared as it now is with other, more recent coolers in this month's test. It's far more than adequate though, and you won't end up disappointed, but it's noticeably off the pace compared with the top chillers. The H100i is consistent in its performance, however, and never takes long to return the CPU back to its idle temperatures once it's stopped being thrashed. It's not topping the cooling charts, but is capable. Interestingly though the peak-to-idle timing dropped as we started pushing up the clockspeeds of the CPU, which speaks to the corsair design of the cooler. Still a worthy chiller, but no longer one you'd rush out and buy...

Verdict

Solid fitting; reliable cooling; link software; off the pace with the top chillers.





WATER COOLER

\$129 | WWW.ENERMAX.COM

Enermax Liqtech 240

Decent cooling, not sure about the licky naming.

We were big fans of Enermax's first water coolers so were intrigued to see how its latest liquid chillers fit into this suddenly super-saturated market. The good news is that the Liqtech 240's unpleasant name doesn't lead to any unpleasantness when it comes to actual performance.

First impressions of this 240mm cooler are very good. The overall package is well-presented and the design of both pump and radiator make it seem like Enermax has genuinely spent time making it stand out without making it needlessly complicated. Simple details, such as the rubber dampeners lining either side of the radiator to keep the fans and mounting extra quiet, really help. Speaking of the fans, both come with physical settings to let them peak at 1,300, 2,000 or 2,500 rpm if you want to push the cooling. We're also pleased to find

two tubes of thermal paste in the package. The fitting is one of the easiest of the lot. The mounting bracket is secured in place with four plastic grommets rather than the potentially PCB-scraping metal bolts of the cooler master. The pump itself comes with a versatile Intel fitting in place, and doesn't need any adjustment to fit on either socket 775, 1150/55/56 or 2011. It makes sticking it to a motherboard and chip already installed in a case a doddle. The cooling performance itself is steady and consistent. Not topping the class, but it's not far off. Interestingly the cooling times are identical whether overlocked or at stock speeds; something none of the other chillers managed.

Verdict

Super consistent; nice overall package; simple fitting; not the overall coolest or quickest.



WATER COOLER

\$135 | WWW.THERMALTAKE.COM

Thermaltake Water 3.0 Pro

Length or girth? Length please.

The pair of Thermaltake water 3.0 coolers in this month's test offer two ways of looking at the whole liquid-chilling process — do you go for a super-long, 360mm radiator or do you plump for a 120mm fat-boy? This here Water 3.0 Pro is that fatboy, offering a radiator that's getting on for twice the girth of its ultimate sibling.

And, were it down to pure cooling performance alone, you could easily make a case for this chubby bast. It is the absolute coolest of all the 120mm coolers in the test, and is capably trading blows with the downright chilliest of even the 240mm jobs. It's not just about the peak cooling performance either — the time to get back to idle temps is impressively quick too, especially for a smaller radiator.

But that's not the whole story. The Water 3.0 Pro is easily the shoutiest cooler we've tested, taking one of the main reasons to opt for

water cooling outside and giving it a bit of a shoeing. We'd generally say one of the benefits of a good water-based chip chiller is the fact it'll operate its fans at lower rpm than an active air cooler. That should mean your whole system gets a bit quieter. Not so with the pro.

Whether it's looking after a stock or overlocked processor the Pro gets super loud as soon as you start pushing the CPU towards 100% load. It's not even the speeds at which they rotate that's the problem; there's a whiney note to their pitch which makes them all the more noticeable. So, while the actual performance is rather impressive, the noisy operation makes it difficult to recommend.

Verdict

Great cooling performance; decent fitting; loud fan noise under load.



apc
HOT PRODUCT



WATER COOLER

\$185 | WWW.THERMALTAKE.COM.AU

Thermaltake Water 3.0 Ultimate

We're gonna need a bigger case...

When it comes to CPU cooling, bigger is pretty much always better. The same goes when you're talking about water cooling reservoirs. There's a reason some open-loop systems use big external reservoirs. But when we're talking about closed-loop chillers, 240mm coolers have been the biggest we've seen. Until now.

This massive 360mm long job is absolutely the most effective CPU cooler of the bunch... although there are likely to be some issues for folk trying to fit it in their existing chassis.

But boy, can this thing cool. Zalman's Reserator just about takes the peak cooling win, but only by a single degree with our overclocked Haswell processor. Thermaltake hoses the Zalman in peak-to-idle performance though — in fact it beats every single other cooler in the test, making it perfect for seriously overclocking PCs.

With a stock-clocked CPU

the Ultimate is able to bring the temp back down to idle almost instantly.

Sadly, most standard ATX chassis simply don't have the necessary space to accommodate this one's length. If you're building a new rig from scratch, however, you could tailor your choice of case to match the awesome cooling.

Realistically though, you are going to struggle to justify the extra \$45 the Ultimate costs over the almost-as-good Cooler Master Nepton 240M. It is a more effective cooler, but is it really \$45 better? We'd say probably not. So, yes, it's an incredibly efficient water cooler, but you really do have to pay for the privilege, and not just in terms of cost, but of space too.

Verdict

Incredible cooling; robust fitting design; quiet; massive radiator could be awkward; rather pricey.



WATER COOLER

\$139 | WWW.ZALMAN.COM

apc
RECOMMENDS

Zalman Reserator 3 Max Dual

Bizarre looks means Reserator.

This reviewer's first experience of a water cooled PC was with Zalman's original Reserator. It was a huge water tower which stood outside your machine, cycling hot water out and feeding cold water back into the chassis. Since then Zalman has become one of the biggest names in PC cooling; it was a bit of a worry when it filed for bankruptcy protection in late 2014.

Thankfully Zalman looks to have escaped by the skin of its heatsinks, which is good news given how effective this weird-looking Reserator 3 Max Dual is. Of all the coolers in this test, the Zalman offers the lowest peak temperatures both at stock speeds and with the overclocked i7-4770k. It manages this in a slightly different way, using a heat-pipe/heatsink combo which looks more vapour chamber than water cooler.

The looping heat-pipes are attached to rubber hoses which push and pull the

coolant to and from the CPU block. The mounted fans chill those aluminium pipes. It's an effective method of dropping peak temps, but doesn't make the setup quicker at returning the chip to its idle temp. The relatively small amount of liquid in the system means it's not as fast as either the Nepton 240m or the Ultimate. Even the old Corsair H100i is quicker and that's having to do it with a larger temperature delta too.

We'd hoped the fans would make fitting easier, but there are a huge number of tiny screws to contend with and a bizarrely complicated mounting mechanism for attaching it to your case. The latest Reserator then is a good cooler, but feels almost needlessly complex.

Verdict

Great cooling performance with low peak temperatures; innovative design. But, awkward fitting.



Why you need a VPN

Virtual private networks can delivery benefits beyond letting you stream Netflix or connect to the company's corporate network.

Stephen Lambrechts explains.

As overseas content services like Netflix and Hulu continue to gain traction, using a personal VPN (virtual private network) to access those services from outside of their intended regions of use has become quite common.

While VPNs are indeed a fantastic way to bypass geo-blocking and gain access to Netflix and other competing services, they have much more to offer. VPNs are generally used by businesses to protect their sensitive and confidential material by allowing employees to remotely connect to a company's internal private network using a secure internet connection, but they can also give the average internet user a 'permanent private mode' for browsing and downloading.

With Malcolm Turnbull's metadata retention scheme posing a genuine threat to the online privacy of millions of Australians, acquiring a personal VPN has never seemed like more of a necessity. Under the proposed federal scheme, the government would retain the right to hold on to your IP address for two years and keep a metadata log of everything you do on the internet.

This is where having a VPN comes in handy — all of the data you send or receive on the internet while using a VPN is encrypted and passes through a tunnel connecting you to a server in another part of the globe. Because of the server's distant location, and the VPN's ability to replace your IP address with one from another country, it becomes practically impossible for third parties to track where you actually are.

A VPN can be set up at a router level, covering every device that's connected to your network, or across individual devices. Most VPN providers will offer a limited amount of simultaneous connections, though applying your VPN settings at a router level will only take up one connection, and will protect everything that's connected to your network.

There is a catch, though — not all routers natively support VPN configuration without being flashed with custom firmware, and doing this might void your router's warranty. We recommend doing some research and

finding a router that comes pre-flashed. You could also opt for a dual router VPN setup, where your primary router is connected to your ISP for normal use, and another flashed router is dedicated to your VPN connection.

VPN apps can be applied to individual devices on your network. This works well across computers, tablets and smartphones, however not all devices support VPN protocols — if you're planning on using your Smart TV, Xbox One or PS4 to watch Netflix, you'll either have to setup your VPN at a router level, or use a VPN alternative,

such as a Smart DNS proxy.

The trick is in choosing the right VPN service for you. There are countless services on the market, with some doing a better job than others at protecting your online anonymity. Security is of course the primary concern of most VPN users, though connection speed, client and server location, price and download restrictions are also of chief importance. We've taken the liberty of testing and rating eight of the top VPN services currently available to see which one reigns supreme.

"There are countless services on the market, with some doing a better job than others at protecting your online anonymity."

LABS RESULTS: VPN SPEED TESTS

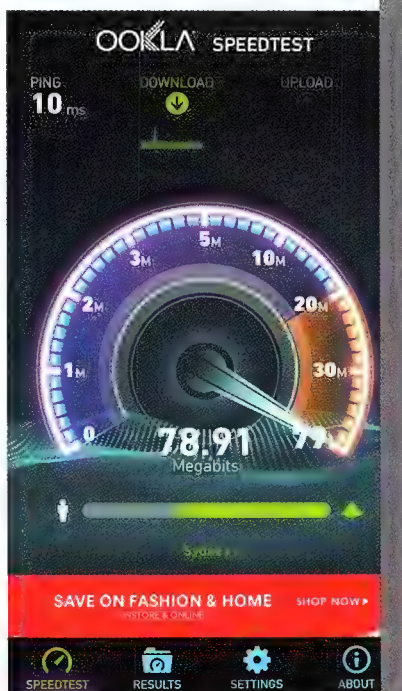
	SYDNEY [AU] TELSTRA	LOS ANGELES, CA [US] DREAMHOST	LONDON [GB] VODAFONE UK	ROTTENDAM [NL] MAXIMUM
NO VPN				
- PING (MS)	3	188	356	328
- DOWNLOAD (MBPS)	94.37	34.66	12.78	30.91
- UPLOAD (MBPS)	93.21	7.79	4.91	5.63
BUFFERED				
- PING (MS)	360	195	326	339
- DOWNLOAD (MBPS)	12.59	35.71	11.29	3.39
- UPLOAD (MBPS)	4.46	15.2	4.7	4.63
EXPRESSVPN				
- PING (MS)	339	189	338	348
- DOWNLOAD (MBPS)	6.25	13.02	13.81	2.61
- UPLOAD (MBPS)	1.61	7.54	2.92	1.95
IPVANISH				
- PING (MS)	337	130	343	350
- DOWNLOAD (MBPS)	7.6	11.3	5.98	7.9
- UPLOAD (MBPS)	3.51	14.96	3.46	1.87
IRONSOCKET				
- PING (MS)	322	174	315	324
- DOWNLOAD (MBPS)	12.23	13.3	7.9	9.72
- UPLOAD (MBPS)	6.79	8.79	1.98	3.23
PRIVATE INTERNET ACCESS				
- PING (MS)	364	195	334	338
- DOWNLOAD (MBPS)	13.66	19.24	5.59	10.25
- UPLOAD (MBPS)	9.66	5.18	1.51	1.8
PUREVPN				
- PING (MS)	520	478	641	640
- DOWNLOAD (MBPS)	7.58	5.99	4.91	8.86
- UPLOAD (MBPS)	1.62	1.66	0.67	0.4
SAFERVPN				
- PING (MS)	325	177	317	323
- DOWNLOAD (MBPS)	5.93	6.96	5.88	5.86
- UPLOAD (MBPS)	1.47	3.4	2.16	2.09
TORGUARD				
- PING (MS)	324	178	317	340
- DOWNLOAD (MBPS)	10.06	17.28	11.83	8.75
- UPLOAD (MBPS)	2.96	5.93	2.5	1.3

Will a VPN slow me down?

In testing for this feature, we were especially interested in finding out whether VPN connections impacted overall speed.

With pretty much every provider, the answer was a clear yes when testing with our 100Mbps NBN connection — you can see the results in the table left.

When testing, for each VPN we connected to the closest West Coast (US) server that we could — what you'd ideally be using to do things like stream Netflix — and then used **SpeedTest.net** to check ping times and download/upload speeds to different locales around the world. As with all internet speed testing, the results we saw were varied and occasionally erratic; we've reproduced them here for your perusal, but your own results will likely differ depending on your own ISP, the time of day, and other factors beyond your control. Speeds will also vary depending on the locale of the VPN server you're connecting to; with most VPN providers offering half a dozen or more servers in different countries and locations, our limited results shouldn't be taken as gospel. If you're eyeing off a subscription to a particular service, it's best to test with your own connection.



US\$15 PER MONTH
[HTTPS://BUFFERED.COM/](https://buffered.com/)

Buffered

Paying for quality.

Clean and simple, Buffered is completely straightforward in its approach. Its minimalistic software client is a breeze to use. Simply click on the flag of the country you want to connect to, and within seconds you're ready to roll. It isn't flashy, but it gets the job done.

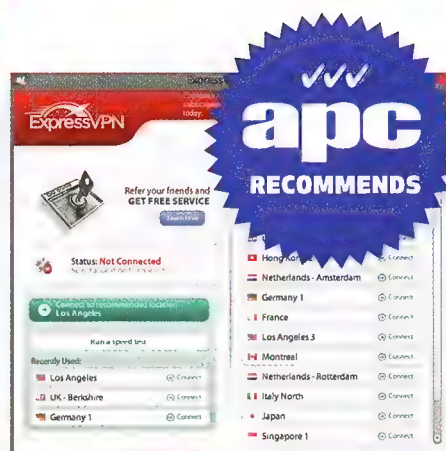
Buffered takes your online security and privacy very seriously. Because of this, it solely uses the OpenVPN protocol and does not support other, less secure protocols such as PPTP and L2TP/IPsec.

The lack of protocol options is sure to annoy those who like to tinker with their VPN settings, but those who only want immediate access to fast servers with strong encryption will be more than satisfied.

While it does have a pricier monthly rate than many of its competitors, Buffered managed to outdo them all in our US West Coast server speed tests. If your primary reason for getting a VPN is to access US services like Netflix, Hulu, ESPN and WWE Network, look no further.

Verdict

Buffered might be pricier than the rest, but it's fastest where it counts.



US\$12.95 PER MONTH
[HTTPS://WWW.EXPRESSVPN.COM/](https://www.expressvpn.com/)

ExpressVPN

Streamlined service with terrific support.

ExpressVPN is a feature-packed VPN service that costs a little more than its competitors, but makes up for it with its stellar customer support and impressive number of server locations — 97 cities across 78 countries!

Its interface is streamlined across all of its platforms and is simple to navigate, though once you've connected to a server, you cannot veer away from the 'connected' screen to view other servers or options without disconnecting, which is somewhat of an annoyance. Another downside to using ExpressVPN is that the service limits you to two simultaneous connections.

Regardless, ExpressVPN delivers when it comes to speed and security. 256-bit encryption ensures that your data remains completely safe when using the OpenVPN protocol. Download speeds are quite good already, but you can opt to use one of the less secure VPN protocols to speed the service up a little bit.

And, if you encounter any problems while using ExpressVPN, live chat support can be reached 24/7 from the ExpressVPN web site.

Verdict

Limited simultaneous connections, but it has a fantastic number of server locations and terrific customer service.





US\$10 PER MONTH
[HTTPS://WWW.IPVANISH.COM/](https://www.ipvanish.com/)

IPVanish

Feature packed with a great interface.

With its big, visually impressive interface, IPVanish impresses right off the bat. A large map interface shows you your server's location with server and IP address info clearly visible. Speaking of IP addresses, in-depth IP settings let you automatically change your IP every single minute for added security if you so desire. And if you have any problems, detailed in-app diagnostics let you find the cause and send support requests. Drop down menus let you pick your VPN protocol and server location, with live ping times next to every available server. You can also see all of your available servers on a large world map, or select a server by use, such as media, gaming or just by fastest server. In terms of security, IPVanish keeps zero logs of your activities online. IPVanish requires even less of your information than other VPNs ask of you. Just an email and password is needed to sign up, and you can avoid giving them your credit card information by using Bitcoin as payment.

Verdict

A great user interface is complemented by excellent security.



Country	Location	P2P Allowed	Configuration
Germany	Düsseldorf	Yes	Get Profile
Australia	Melbourne	No	Get Profile
USA	New York	Yes	Get Profile
UK	London	No	Get Profile
France	Paris	No	Get Profile
Canada	Toronto	No	Get Profile
Japan	Tokyo	No	Get Profile
South Korea	Seoul	No	Get Profile
China	Beijing	No	Get Profile
Hong Kong	Hong Kong	Yes	Get Profile
India	Mumbai	No	Get Profile
Brazil	Sao Paulo	No	Get Profile
Argentina	Buenos Aires	No	Get Profile
Colombia	Bogota	No	Get Profile
Peru	Lima	No	Get Profile
Venezuela	Caracas	No	Get Profile
Chile	Santiago	No	Get Profile
Ecuador	Quito	No	Get Profile
Costa Rica	San Jose	No	Get Profile
Panama	Panama	No	Get Profile
Dominican Republic	Santiago	No	Get Profile
Paraguay	Asuncion	No	Get Profile
Uruguay	Montevideo	No	Get Profile
Vietnam	Hanoi	No	Get Profile
Thailand	Bangkok	No	Get Profile
Philippines	Manila	No	Get Profile
Malaysia	Kuala Lumpur	No	Get Profile
Singapore	Singapore	No	Get Profile
Indonesia	Jakarta	No	Get Profile
Myanmar	Nay Pyi Taw	No	Get Profile
Burma	Nay Pyi Taw	No	Get Profile
Laos	Vientiane	No	Get Profile
Cambodia	Phnom Penh	No	Get Profile
Sierra Leone	Freetown	No	Get Profile
Liberia	Monrovia	No	Get Profile
Ivory Coast	Abidjan	No	Get Profile
Ghana	Accra	No	Get Profile
Nigeria	Lagos	No	Get Profile
Kenya	Nairobi	No	Get Profile
Tanzania	Dar es Salaam	No	Get Profile
Uganda	Kampala	No	Get Profile
Rwanda	Kigali	No	Get Profile
Burundi	Gitega	No	Get Profile
DRC	Kinshasa	No	Get Profile
Congo	Brazzaville	No	Get Profile
Angola	Luanda	No	Get Profile
Mozambique	Maputo	No	Get Profile
Botswana	Gaborone	No	Get Profile
Lesotho	Maseru	No	Get Profile
Namibia	Windhoek	No	Get Profile
South Africa	Cape Town	No	Get Profile
Zimbabwe	Harare	No	Get Profile
Malawi	Lilongwe	No	Get Profile
Mozambique	Maputo	No	Get Profile
Swaziland	Mbabane	No	Get Profile
Eswatini	Mbabane	No	Get Profile
Lesotho	Maseru	No	Get Profile
Namibia	Windhoek	No	Get Profile
South Africa	Cape Town	No	Get Profile
Zimbabwe	Harare	No	Get Profile
Malawi	Lilongwe	No	Get Profile
Mozambique	Maputo	No	Get Profile
Botswana	Gaborone	No	Get Profile
Lesotho	Maseru	No	Get Profile
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South Africa	Cape Town	No	Get Profile
Zimbabwe	Harare	No	Get Profile
Malawi	Lilongwe	No	Get Profile
Mozambique	Maputo	No	Get Profile
Botswana	Gaborone	No	Get Profile
Lesotho	Maseru	No	Get Profile
Namibia	Windhoek	No	Get Profile
South Africa	Cape Town	No	Get Profile
Zimbabwe	Harare	No	Get Profile
Malawi	Lilongwe	No	Get Profile
Mozambique	Maputo	No	Get Profile
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Zimbabwe	Harare	No	Get Profile
Malawi	Lilongwe	No	Get Profile
Mozambique	Maputo	No	Get Profile
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US\$7.95 PER MONTH
[HTTP://WWW.PUREVPN.COM/](http://www.purevpn.com/)

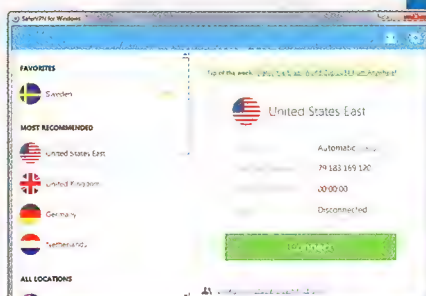
PureVPN

Nice dashboard let
 down by slow speeds.

Personalisation is what PureVPN is all about. With its user-friendly dashboard, PureVPN has different modes that allow you to choose speed over security, or vice-versa, or even the best of both worlds. Unfortunately, even with the speed option enabled, PureVPN underwhelmed in our speed tests. Still, you can select servers by country or purpose – if you specifically want the best connection for streaming Netflix USA, or one of the many other country specific services listed, you can just pick it from the drop down menu. Split Tunneling (still in beta) gives the user the power to choose the applications that go through the VPN. Add-ons for Smart DNS and Web Protection are also available. A detailed traffic chart lets you see every kilobyte that goes in or out, and you also have the option to choose which protocol you use. But if you don't care about that stuff, you can just set PureVPN to automatically select the protocol and the fastest server available.

Verdict

It has a great dashboard that's easy to use, but the service's download speeds leave a lot to be desired.



US\$7.99 PER MONTH
[HTTPS://WWW.SAFERVPN.COM/](https://www.safervpn.com/)

SaferVPN

For VPN novices only.

With its colourful software interface and easy to grasp layout, SaferVPN immediately feels approachable and simple without sacrificing the features we've come to expect from a VPN service. Even the most inexperienced VPN user should have no problem understanding how to use it within minutes, making it ideal for the casual Netflix viewer or person who just wants some privacy on the internet.

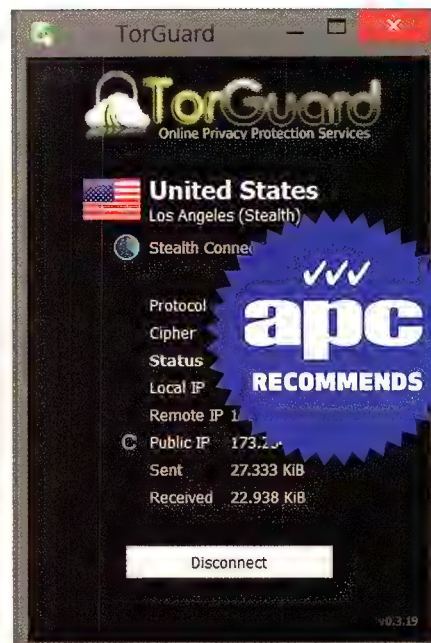
That said, options are available for users who want to change their VPN protocol settings, run speed tests and create support tickets.

Unfortunately, SaferVPN's server numbers are paltry in comparison to some of the other VPN services on the market, with only 20 server locations to choose from at present. Add to that the middling speeds achieved in our speed tests, and it becomes hard to recommend SaferVPN to experienced VPN users.

Still, unlike most other VPN services, SaferVPN offers a completely free 24-hour trial period that does not require a credit card, so there's no harm in testing it out for yourself.

Verdict

So easy, even a chimp could use it, though lack of servers and weak download speeds will turn off experienced users.



US\$9.99 PER MONTH
[HTTPS://TORGUARD.NET/](https://torguard.net/)

TorGuard

Like a warm security
 blanket.

The anonymous use of BitTorrent is one of TorGuard's major selling points, and the service wears this purpose like a badge of honour with its various VPN and BitTorrent Proxy packages. TorGuard advertises its effectiveness at masking your privacy while P2P downloading on selected servers that aren't in high-risk countries.

TorGuard's interface comes in two flavours: TorGuard Lite, which is small, simple and allows you to choose from a vast selection of servers in over 42 countries but gives you little else in terms of customisation, and a Viscosity Build OpenVPN client, which offers more options, server status information and detailed diagnostic statistics. The Viscosity Build does require you to pay a couple more dollars for a license in order to connect, so if you aren't interested in that stuff, the Lite version will give you everything you need. You also get access to five simultaneous VPN connections with TorGuard, which is more generous than most other VPN providers on the market. ■

Verdict

A heavy focus on security, good speeds and a large number of simultaneous connections make TorGuard easy to recommend.



howto

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

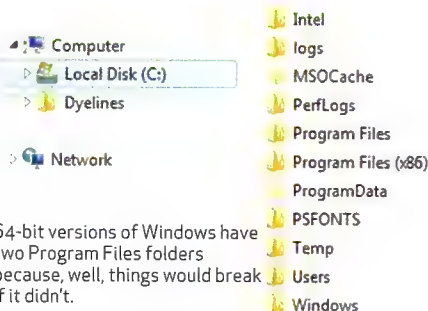
WINDOWS

WHAT DOES THE (X86) MEAN?

Why are there two Program Files folders on my hard disk? Program Files (x86) is 110GB on my system whereas Program Files is only 508MB. They seem to have several duplicated folders inside them. Do I really need both? Is there some way to merge them?

— Taj Suleiman

The short answer is the Program Files (x86) is for 32-bit applications and Program Files is for 64-bit apps. The short version of the really, really long answer is that 32-bit apps can't load 64-bit DLLs and will crash if they try, so they need to be kept separate. There are lots of 32-bit apps around that predate 64-bit operating systems, so they don't know that 64-bit DLLs are even out there and will trustingly try and load the first file they find with the right name. There are several ways this problem could have been solved, but the one that Microsoft chose was to create two top-level folders and when a program installer calls the SHGetKnownFolderPath function, Windows checks whether the installer is 32-bit or 64-bit and returns the path to the correct



Program Files folder for that application. Program Files (x86) is much larger on your PC because there are still an awful lot of 32-bit apps out there.

Luis Villazon

HARDWARE

SMALL FORM, BIG HOPES

I'm looking to beef up the system I built in 2011 for Battlefield 3 gaming. It has an ASUS P8P67LE motherboard, Intel Core i5-2500 CPU, 8GB of RAM, ASUS GeForce GT 440, and a 1TB WD Blue hard drive in an In-Win mid-tower. This is mainly a gaming rig with occasional video editing and Photoshop. Can I transfer this setup to a small form factor case, and if so, what case

would fit? I'd also like to install an SSD. Lastly, do I need to upgrade my CPU or just my video card? My budget is \$400. Your recommendations will be most appreciated.

— Gerick

You're not going to get a technical small form factor case that takes a full size ATX motherboard. There are certainly smaller tower cases that are almost the size of large Micro-ATX boards, but you're not going to get that board in a SFF case. Your best upgrade would be to buy an SSD, a truly life-changing moment in computing. Second, your GeForce GT 440 is way behind the curve, even for Battlefield 3. With a budget of \$400, we'd pick up a 240GB SSD for about \$140. That leaves \$260 for your video card budget, which could net you AMD's Radeon R9 280. Two things to remember — the R9 280 will consume more power than your GT 440 and will require two six-pin GPU power plugs. If your PSU isn't up to it, you'll have to upgrade that or scale back your graphics ambitions. Or you could peel off from the GPU budget to buy a Radeon R9 270X with a newer PSU or, if you decide against the PSU, you can pick up the power-sipping GeForce GTX 750 Ti. Some GTX 750 Ti cards don't even require external power, while some do. So check your PSU first.

APC team

HARDWARE

IS THERE A MERIT BADGE FOR THAT?

I'm trying to donate an old computer to my



Nvidia's GeForce GTX 750 Ti offers good performance for low power systems.

"I went over all of the connectors just to be sure everything was connected, stress tested it, took it back, and the same thing happened. I tried 12 different outlets in five different rooms but none of them worked."

son's Scout troop. I reinstalled Windows, did all of the updates, installed all of the software they will need, and ran it for a couple of days to ensure everything worked. I took it to their next meeting, plugged it in, and only the green power light would turn on. There was no fan activity, no drive activity, just the light turning on. I brought it home and plugged it in and it booted up just fine. I went over all of the connectors just to be sure everything was connected, stress tested it, took it back, and the same thing happened. I tried 12 different outlets in five different rooms but none of them worked. Also, the old computer they have (a Compaq Evo with a Socket 478 Pentium 4 chip) starts up OK. The power supply in the computer I am donating is a PC Power & Cooling 350W job. Let me repeat: It works just fine at home, but not in their building.

— Thomas R. Matzat

The APC team likes the path of least resistance so we're assuming you brought your own power cable with you. If you didn't, you should, or use the cable from the other PC that does work. We're certain you did that though, so it sounds like an issue with the wiring in the building, or perhaps a voltage issue. It's possible the PSU in your PC can't work under a certain voltage but that their older Compaq Evo can. It's hard to believe though, as that would mean the input power from the building is likely below 200 volts. If you have a line conditioner or a UPS, try your PC with that. Since this is the Boy Scouts, is it possible the building is in a remote location operating on a generator? That can also play havoc with devices. If your PC works with a line conditioner or UPS, that would indicate there's an electrical issue in the building that should be checked by a qualified electrician.

APC team

HARDWARE

RAM UPGRADE?

I recently upgraded my RAM from Crucial Ballistix Tactical 8GB (1,333MHz) to Team Vulcan 8GB (2,133MHz), which is the

A UPS can be helpful in troubleshooting mains-power problems.



maximum frequency supported by my board (MSI 970A-G43). I used a program from the Windows store called PC Benchmark to check my performance. However, the program reports my RAM is actually slower, as I went from a score of 1,382.4 to 1,197.57. Also, Windows 8's Task Manager is reporting a frequency of 1,067MHz (I understand that Windows reports exactly half of the actual frequency). I thought I observed a slight performance increase in loading certain programs but maybe it was just in my head. Can you tell me what the deal is with my new RAM? I have an AMD FX-8350 CPU, Samsung 840 500GB SSD, and a AMD Radeon HD 7770 GPU.

— Devon

Memory bandwidth rarely gives results you can "feel" outside of

synthetic benchmarks. We say this with the caveat that Intel's latest Haswell CPUs do actually pick up some mileage from higher bandwidth memory in checks outside of the synthetic tests. If you want to see the increase in bandwidth, drop in the old RAM and run the free version of SiSoft Sandra. It has a host of tests including a synthetic memory benchmark that should show a nice bump. Will that matter? That's hard to say as outside of encoding and the synthetics, we haven't seen enough of an increase to warrant paying exorbitant fees for the faster RAM. Again, that's changing as Haswell and beyond seems to give performance benefits.

APC team ■

Upgrading your system to higher-speed RAM doesn't usually give results you can feel.



Size and arrange charts using macros

Helen Bradley shows how to size and place charts in an Excel worksheet.

It takes a person time and effort to size and place multiple charts neatly on an Excel worksheet. Luckily it takes a macro almost no time to do the same thing. This month's macro resizes and arranges charts into a neat grid on a worksheet.

THE SCENARIO

Our macro to size and arrange charts cycles through all the charts on the worksheet one at a time. It resizes each chart to a predetermined size and places it in a grid arrangement. All the configurable data is located in one area of the macro so it can be easily altered, if desired. This same data could also be entered at run time using a custom form – but we'll leave it up to you to do that!

The trickiest part of this macro is determining the chart's row and column position in the grid. It's handled neatly by some creative math using the loop counter. The remainder when the

loop counter is divided by the number of columns in the intended grid gives a value that, when combined with some math, positions the chart in the right position relative to the left margin of the worksheet. The same loop counter, when divided using integer divide (which returns the integer when one number is divided by another) provides a second value which, again combined with some simple math, can be used to position the chart in the correct position relative to the top of the worksheet.

This is the code for the project:

```
Sub chartResizeAndPosition
()
    Dim cht As ChartObject
    Dim numCols, chtWidth,
    chtHeight, chtGap,
    chtStartLeft, chtStartTop,
    resetLeft, chartCount As
    Integer
```

```
'configurable data follows
chtWidth = 250
chtHeight = 150
chtStartLeft = 75
chtStartTop = 100
chtGap = 10
numCols = 2
'end configurable data
```

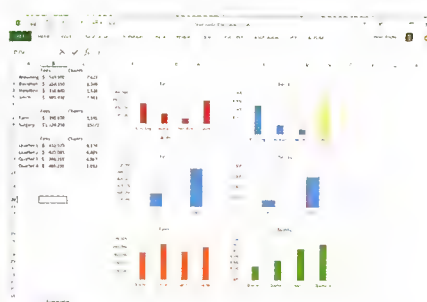
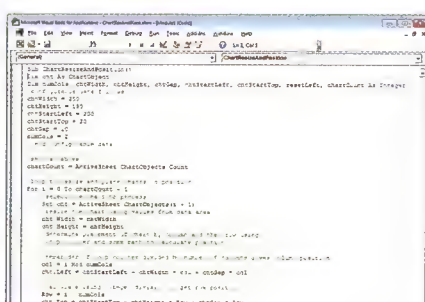
```
chartCount = ActiveSheet.
ChartObjects.Count
```

```
For i = 0 To chartCount - 1
    'select the chart to process
    Set cht = ActiveSheet.
    ChartObjects(i + 1)
    'resize the chart
    cht.Width = chtWidth
    cht.Height = chtHeight
    'remainder of loop counter
    divided by number of columns
    gives column position
    col = i Mod numCols
    cht.Left = chtStartLeft +
    chtWidth * col + chtGap * col
    'calculate using integer
    division to get row position
    Row = i \ numCols
    cht.Top = chtStartTop +
    chtHeight * Row + chtGap * Row
Next
End Sub ■
```

"It takes a person time and effort to size and place multiple charts neatly on an Excel worksheet."

Tidy up

Run the macro to resize and reorganise your charts.



1 Download the example file from www.apcmag.com/magstuff. We've placed nine charts haphazardly in this workbook.

2 Type the macro code into a new module in the Visual Basic Editor. Save the worksheet and the associated code.

3 Test the macro by running it. It will process each chart in turn sizing and positioning it in the worksheet. Change the values in the macro's data area to change the size and arrangement of the charts. ■

disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

ISSUE #12, FEBRUARY 2015

TAKE SCREENGRABS LIKE A PRO

Capture and annotate screenshots with Ashampoo Snap 7

FULL VERSION WORTH \$20

Ashampoo Snap 7 is the smartest way to capture screenshots, add notes and annotations and share them with your friends. With Ashampoo Snap 7 you can capture images and videos right from your screen in seconds, and is ideal for beginners and professionals alike. With this latest edition, improvements to the user interface mean less complexity and a smarter work environment, employing less clicks to achieve your goal.



NEVER FORGET A BIRTHDAY AGAIN

Quick and easy reminds with 1-abc.net Birthday Reminder 7

FULL VERSION WORTH \$15

There are many ways to get notifications about birthdays on your computer, but most of them are just too complicated. 1-abc.net Birthday Reminder makes it much easier: a message pops up on the day when you want to be reminded, and you can decide if you want to have it automatically load when Windows starts or if you want to run the program in the background.



KEEP YOUR HARD DRIVES IN IMMACULATE CONDITION

Monitor performance with CheckDrive Plus 2014

FULL VERSION WORTH \$15

CheckDrive offers you an easy way of checking your PCs hard drives for errors. Errors can then be fixed immediately. CheckDrive displays information about your drives and determines if they need cleaning or defragmentation. Meanwhile, the Background Guard quietly monitors each hard drive and displays notifications if an error occurs. With the Plus version, users can schedule regular checks.

SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The APC disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the APC disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the APC disc have different system requirements. Software is included on the disc for Windows Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the APC disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the APC disc, please visit www.apcmag.com/disc.htm.
- APC provides no technical support for this disc or any software provided on it.

NO DISC?

Please note the free cover disc is not included with digital editions or bundled promotional copies of APC.

PLUS! SUPER WOLFENSTEIN HD: FULL GAME & 6 TOP WINDOWS MEDIA TOOLS

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Safely clean the Registry

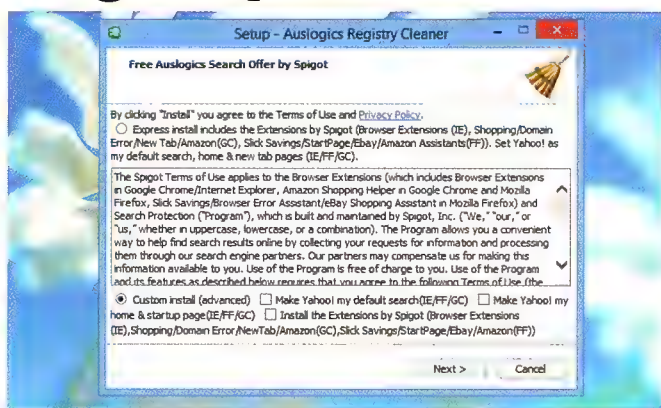
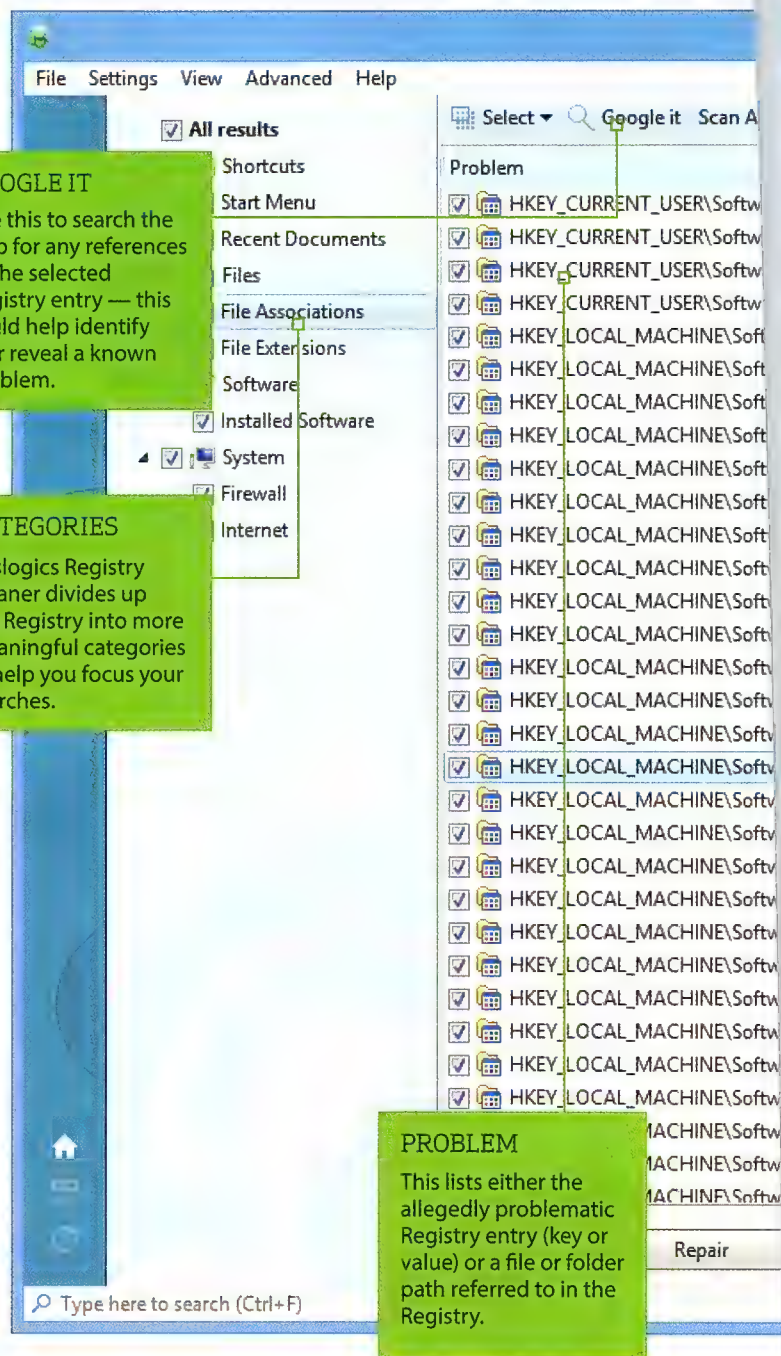
Registry cleaning tools should be used with care – Nick Peers shows you how best to utilise them.

Let's be honest: I'm not a big fan of Registry cleaning tools. I've seen first-hand the damage they can do to perfectly functioning Windows systems. They're often billed as a magic cure for problems or promise performance improvements, but if you scan blindly and let a Registry cleaning tool simply delete everything it finds you'll eventually run into trouble – and you won't notice any speed boost either.

Despite all this, Registry cleaning tools can help fix problems by tracking down rogue entries and deleting them – the trick is knowing how to use them carefully.

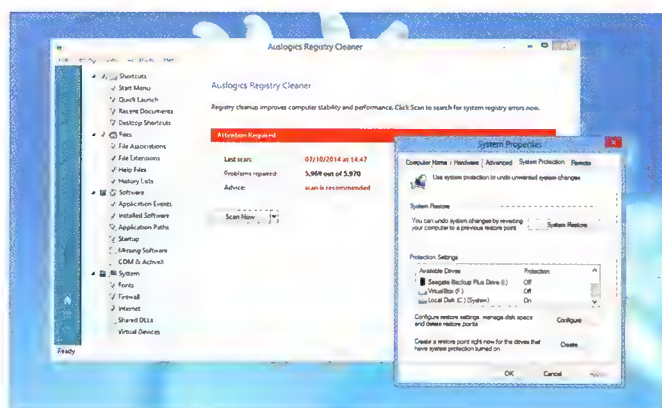
In this tutorial, I'll show you how to selectively search for, analyse and remove entries. Just as importantly, I'll also reveal how to put them back again should your clean-out create more problems than it solves...

Remove rogue Registry entries



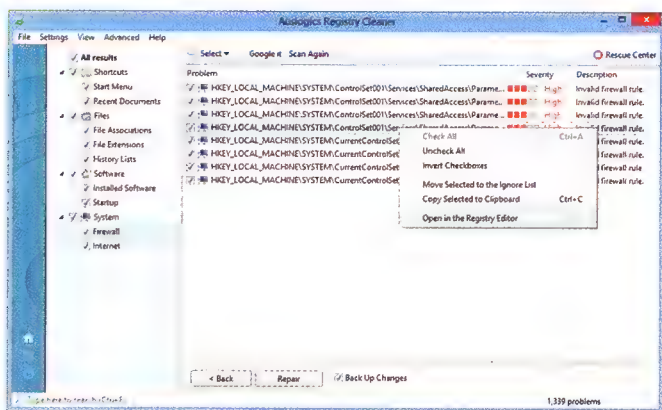
1 INSTALL PROGRAM

Download and install Auslogics Registry Cleaner from www.auslogics.com/en/software/registry-cleaner/. During installation you'll be prompted to install Auslogics BoostSpeed alongside it; we recommend unticking this box. The next screen offers additional programs – select 'Custom install (advanced)', with no additional boxes ticked, to skip installing them all.



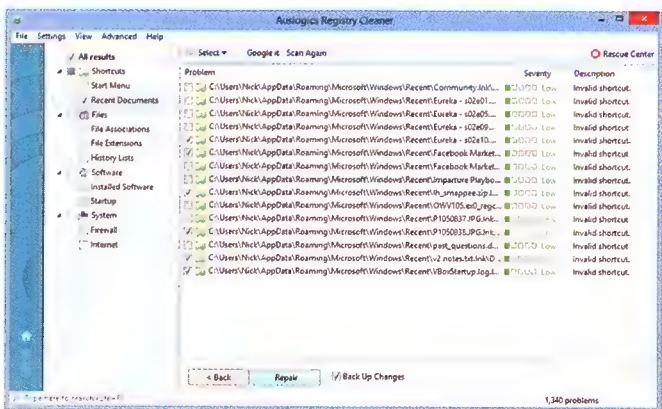
2 TAKE PRECAUTIONS

Before proceeding any further, take a System Restore point: open the Start menu or press 'Win-Q' to open the Search charm in Windows 8. Type **system restore** and click 'Create a restore point' under Settings. Click Create, give your Restore point a suitable name and click Create again to set up a fail-safe backup which you can restore should it prove necessary.



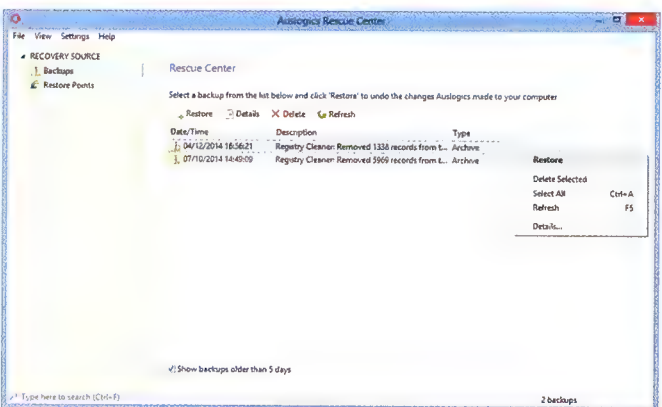
EXPLORE IN DEPTH

Use the annotation on the previous page to help identify problem entries. Most entries should yield some clue to their origin. Look for references to a specific program, or click the 'Google it' button to perform a search using that Registry key or value, which may throw up people with similar problems and — if you're really lucky — potential solutions to try.



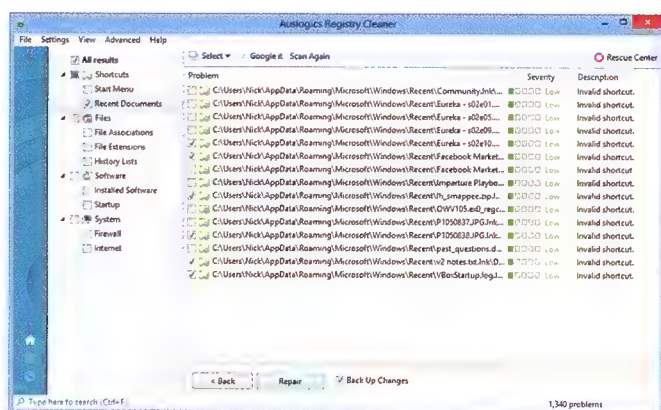
BE SELECTIVE

Alternatively, right-click 'All results' and choose 'Uncheck all' to select nothing by default. Now manually place a tick next to the entries you wish to remove. When you're done, verify 'Back Up Changes' is ticked, then click 'Repair' to remove only those entries you've selected. After the repair completes, click 'View detailed report' to see exactly what was deleted, if necessary.



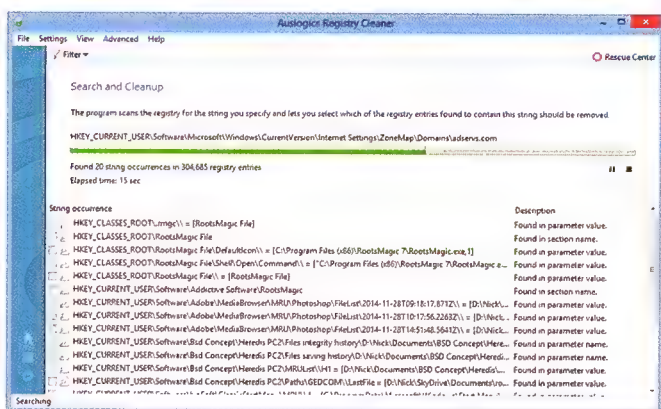
RESTORE KEYS

Should you run into new problems after cleaning the Registry, select 'File > Rescue Center' to browse available backups and Restore points. Start by right-clicking your most recent backup and choosing Restore — click Yes to restore all deleted entries from that backup (you can't choose single entries). If this fails to work, select 'Restore Points' and your System Restore file.



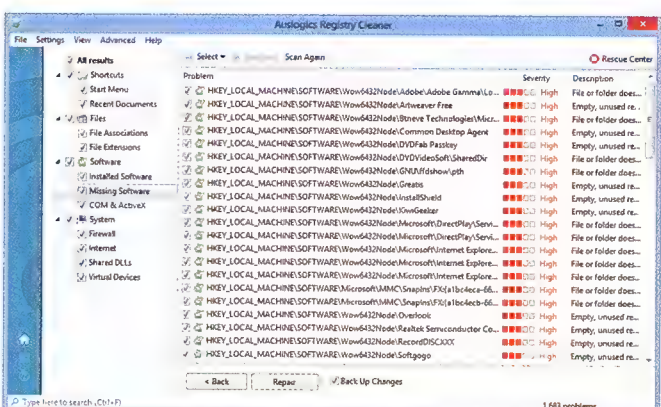
SELECT ALL AND REPAIR

By default, all problems are selected — clicking 'Repair' removes them all. If you're unable to identify a specific Registry entry that you believe is causing your problem you could — with some risk — try removing them all. Click Repair, then reboot and analyse to see if the problem has gone. If it hasn't, or other problems emerge, jump to step nine to restore the backup.



SEARCH FOR REGISTRY KEYS

Select 'View > Find Registry Keys' to perform a manual examination of the Registry for keys to examine and potentially delete. Use the Filter button before clicking Search to restrict your search. Note that Auslogics Registry Cleaner provides no indication of whether a key is a problem or not; it simply returns all results. Manually select entries to delete, then 'Clean up'.



REGISTRY CLEANING MADE EASY

Armed with these tips, you should now be able to safely remove Registry entries when the need arises — advanced users can go even further and include more 'dangerous' sections of the Registry, including 'Missing Software' and 'Shared DLLs', when scanning for problems. Note that indiscriminately cleaning these sections could cause major problems, so proceed with caution.

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Make a Linux media server

Use your Linux computer as a server and enjoy your media collection from anywhere, on any device. Neil Bothwick gets to grips with Plex.

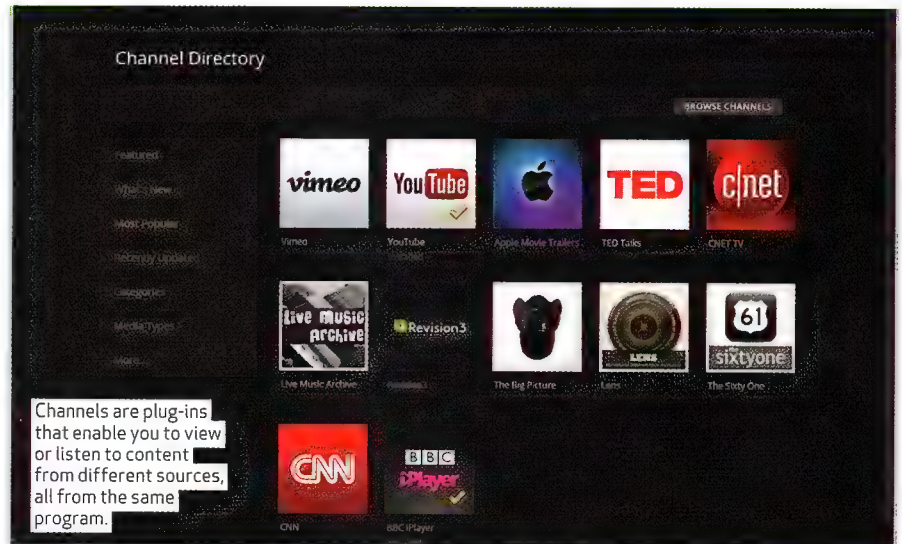
Many of us have collections of films and TV shows scattered across one or more computers. This presents two problems (in addition to finding the time to watch it all). The first is organising it so you know what's there; the second is making it available to all your devices. There are several possible solutions. We've looked at XBMC before, but this time we'll cover Plex Media Server.

Plex uses the classic client/server architecture. The server runs on the computer providing your media files, either stored locally or on mounted network shares. Clients run on whichever devices you use to view the videos. The Plex server is available for some makes of NAS as well as Windows and Mac OS, but we will naturally be using a Linux PC. The server does all the donkey work, maintaining a database of files, downloading metadata and transcoding video into a format that a client can play. If the file is stored in a format that your client can play, it will be used as-is. If not, Plex will transcode it on the fly, so you need a reasonably powerful system to run the server. Transcoding is also used to reduce the resolution or bit rate – when watching videos on a mobile device via 3G, for example, the client will request a suitable format.

INSTALLING PLEX

First, you should know that although the Plex Media Server software is free of charge, it isn't open source, so free software purists may want to turn the page now. Packages for Ubuntu, Fedora and CentOS are available from the downloads section of plex.tv, but check your distro's package manager first – many distros have packaged it. Once it's installed and running, point your web browser at <http://localhost:32400/web> (replace localhost with the hostname or IP address if you installed it on a different computer).

You need to set up a free account with Plex. Among other things, this helps when connecting to your server from outside your network, but you can choose to not be connected externally once initial setup is complete. You will probably need to forward port 32400 on your router to your Plex server; once again, you can remove this later if you



"Although the Plex Media Server software is free of charge, it isn't open source."

don't want to access your content from outside. When you are at the Plex web interface, click the Settings icon at the top right and go to the Connect section to give your Plex account details. You can browse the other settings, but the defaults are usually good to start with. Now you can start adding media. Plex expects files to be named in a particular way: specifically it wants TV shows organised as Show_Name/SeasonN/Show_Name SxxEyy.ext. This enables Plex to sort them correctly and also to retrieve series and episode information from online databases.

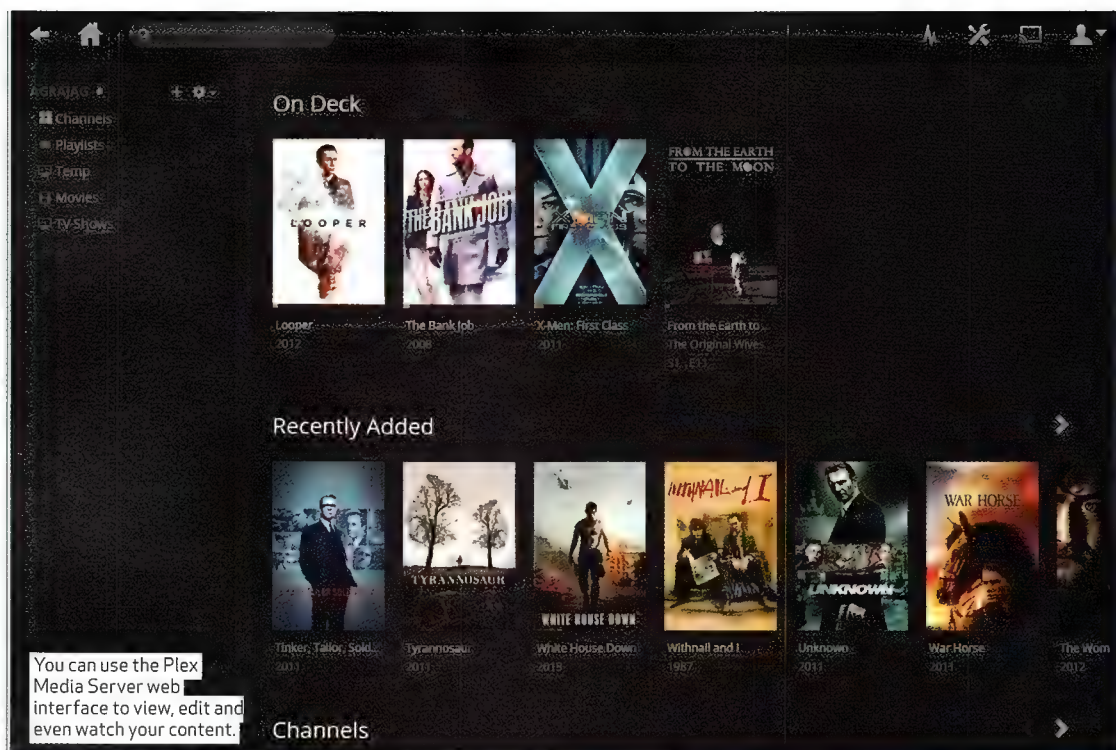
Click the home icon and on the left of the screen you will see the server name with a + to its right. Click that, pick the type of media to add and click Add. Now you can add one or more folders containing your files. There are three different types for video: Movies, TV Shows and Home Videos. Plex presents these separately. It expects movies to be named in the format 'Title (year).ext' so it can retrieve the correct metadata, while the Home Videos category is for any other type of video, whether created at home or downloaded.

PLAYBACK

The web interface includes a basic

player, so you don't need any other software, but there are more capable options. If you have Chrome or Chromium installed, there is a web app that runs the player separately from the browser. There's also a full-featured player called Plex Home Theatre. This is currently only officially available for Windows, but it is a derivative of XBMC and open source, so packages are available. If your distro doesn't have one already, there are instructions for a number of distros at tinyurl.com/lc3y2qr. This includes links to repositories, as well as build instructions, so it's available for all distros if you don't mind a little work.

One of the reasons for using a client/server arrangement is that you can keep your powerful PC that does the transcoding and other hard work out of sight (and hearing), and use a small, quiet, efficient device connected to your TV. The good news is that everyone's favourite small and quiet Linux device, the Raspberry Pi, has a build available in the form of RasPlex (www.rasplex.com), an OpenELEC-based distro with Plex Home Theater. While I have found the Pi to struggle with vanilla XBMC, Plex's transcoding means it only has to play formats that the hardware can



handle, giving a much better experience. Setup is as simple as writing the image to an SD card, booting the Pi and logging in. You only need to log in once; it is used to authorise a permanent connection between RasPlex and your Plex server.

THERE'S MORE

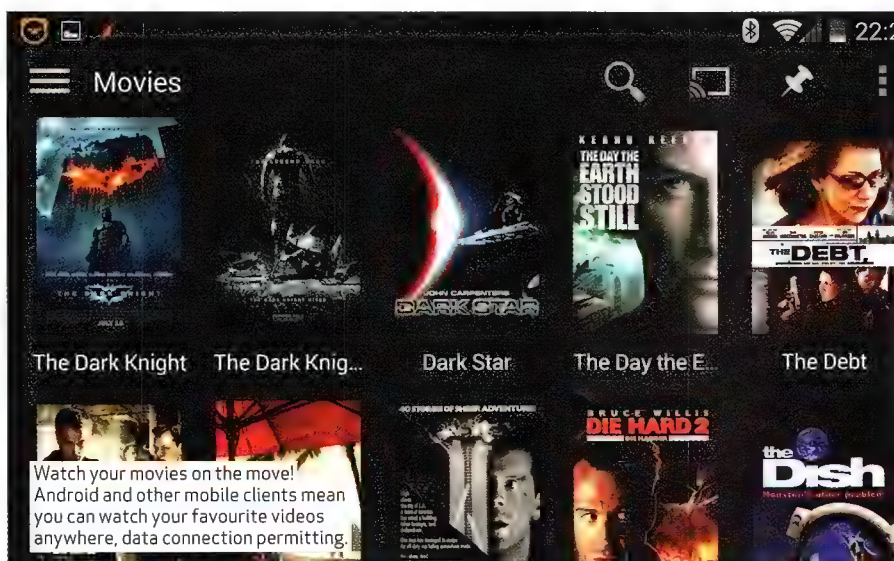
Mobile devices are well catered for, with apps for Android and other, less popular, mobile devices. There is also a Roku app. If you want to watch on your TV but don't mind using a browser or mobile device to start the process, Plex works with Google's Chromecast too, starting the playback through a Chrome tab (using the Cast extension) or the mobile app.

In addition to playing various video

formats, Plex does a good job of playing music and showing photos, but that's not all. Look at the menu on the left of the home screen and you'll see the option Channels. These are plugins to play content from online sources such as YouTube. There are a few installed by default, but the Install Channels button on the Channels page offers many more. These are installed with a simple click, but there are some more experimental channels available. If you want Plex to be able to play your MythTV recordings, complete with metadata, or play from your Amazon video account, then search the forums for links to channels that you can download and install manually. Plug-ins are tarballs that unpack to a bundle directory. Unpack them into your plug-ins directory –

usually at `/var/lib/plexmediaserver/Library/Application/Support/Plex/Media/Server/Plug-ins/` – and restart the server. Yes, that really is the correct path – no prizes for guessing that Plex was not originally developed on Linux!

Once your server and client are set up, and there's some content in your library, there are plenty of settings to try. In particular, if you want to play videos on mobile devices, you may want to set the transcoder bit rates and quality for this to avoid eating up your data allowance. The support section of the Plex web site has plenty of documentation to help you get the most from it. Plex has an active community, with plenty of advice, help and information available in its web forums. ■



Plex Pass

While Plex is free of charge to use, there is a fee for extra services. Buying a Plex Pass (as a monthly, yearly or lifetime subscription) adds features, including the ability to sync media to your mobile devices for offline viewing, automatic upload of photos from your phone, shared media libraries and a few more extras. It also gives you a free app for Android — the standard one has a small charge. None of this is needed to use Plex, especially if you only want to use it over your home network, but the extra options may be worthwhile for you.

How to secure (some of) your stuff

If you've got some files you need to keep away from prying eyes, Matthew JC. Powell shows you how to build a strong lock for them.

You're probably aware of FileVault — OS X's inbuilt mechanism for securing your files behind strong encryption. It's been around since OS X 10.3, and since Lion (10.7) it's operated in an entirely different (and better) way. For the extremely security-conscious, it's a pretty good way to keep your stuff safe — but it has its drawbacks.

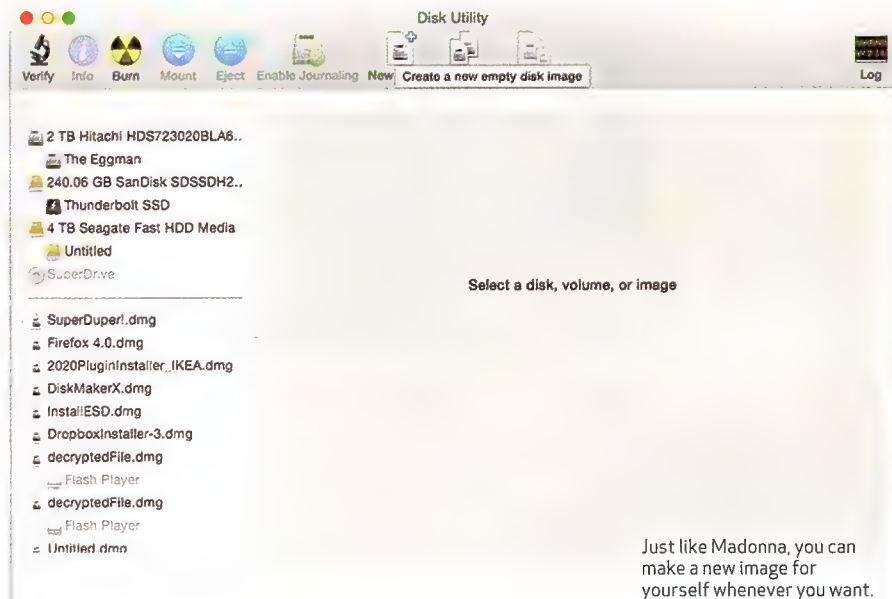
The way it used to work was by turning your entire Home folder (the folder that has your username on it) into an encrypted disk image. When you logged out, the image was locked and no-one who didn't have your password had no hope whatsoever of getting into it. Of course this entailed a significant performance hit. It also meant that your whole user folder was seen by Time Machine as a single monolithic file, making backups tedious — every change meant backing up a new copy of the entire file.

"The changes made FileVault less secure — there was even a downloadable utility that could break the encryption."

Later revisions changed that, but the changes made FileVault less secure — there was even a downloadable utility that could break the encryption.

Enter FileVault 2 in OS X 10.7. It no longer turns your entire user folder into an encrypted disk image. Rather, it locks the entire volume — all user folders, all applications, even the system itself — using encryption algorithms built into the latest generation Intel processors. In fact, it's one reason recent operating systems are not considered compatible with older processors — FileVault 2 wouldn't work.

This is great if you're on fairly new hardware — the performance hit isn't too bad, especially if you're using an SSD-based Mac rather than one with a mechanical drive. If, however, your



machine is more than a couple of years old, or if you've got a mechanical drive with terabytes of data on it, all that locking and unlocking can become a noticeable time-suck.

If you're not actually Edward Snowden, it's probably not worth it.

If you've just got a few documents, images and things like that which you want to keep locked away, you can still do things the old FileVault way, but with a much smaller encrypted disk image rather than your entire Home folder.

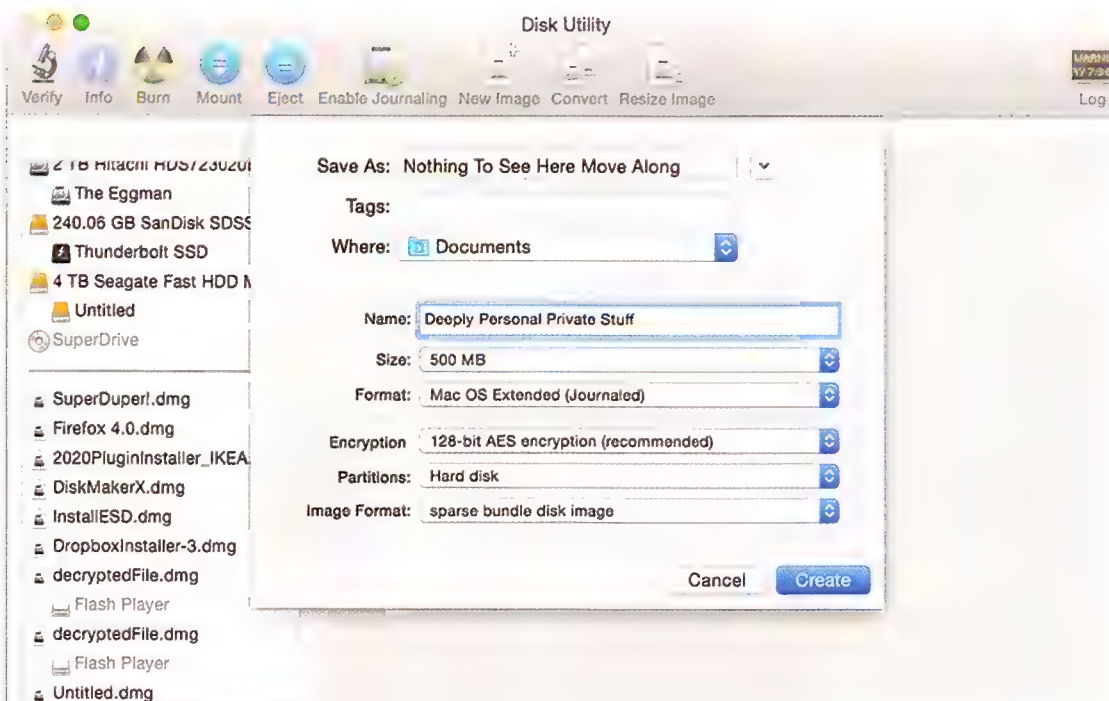
Create a Disk Image by opening Disk Utility (in 'Applications > Utilities') and click on 'New Image' in the toolbar. Give it a name and choose where to save it. (Note that what you put in the 'Save As:' field does not have to be the same as what you put in the 'Name:' field —

the former is the filename it will have when not mounted, the latter is the name it will have when mounted as a disk.)

Choose a size for it, remembering that the bigger it is the slower it will be to encrypt/decrypt and the more laborious it will be to back up. Leave 'Mac OS Extended (Journaled)' as the format, unless you have a particularly good reason not to.

Next, choose an encryption method. 128-bit AES encryption is the same as FileVault 2 uses, and it's considered pretty darn secure. If you want to go one better, you can choose 256-bit AES encryption, but again remember that the bigger the image, the slower this will be. Weigh up how secure you really need these things to be and how determined someone is likely to be to get at them. If they're snapshots you'd rather your kids didn't get at, go 128-bit. If they're nuclear launch codes, go 256-bit.

For the 'Image Format:' field, your choices are: sparse bundle disk image; sparse disk image; read/write disk image; and DVD/CD master. Obviously we'll ignore the last, as it's not relevant here. The default setting is 'read/write disk image' and if you're unsure what



The options for the type of disk image you can create may seem bewildering, but once you understand them it's quite straightforward.

you want it's a safe choice.

A sparse disk image is kind of cool, in that it actually only takes up as much space as its contents. So you can create a 1GB sparse image and if it only contains 100MB of stuff, that's how much room it will take up. A 1GB read/write disk image will take up 1GB even if it's empty. The sparse image will grow as you add stuff to it, up to the predefined maximum you set in the 'Size:' field.

A sparse bundle disk image is even cooler, in that rather than appearing as a file it appears as a package (much like OS X applications do), containing a bundle of 8MB bands. So not only does it only take up as much space as its contents, but from a backup

perspective only the bands that change need to be updated.

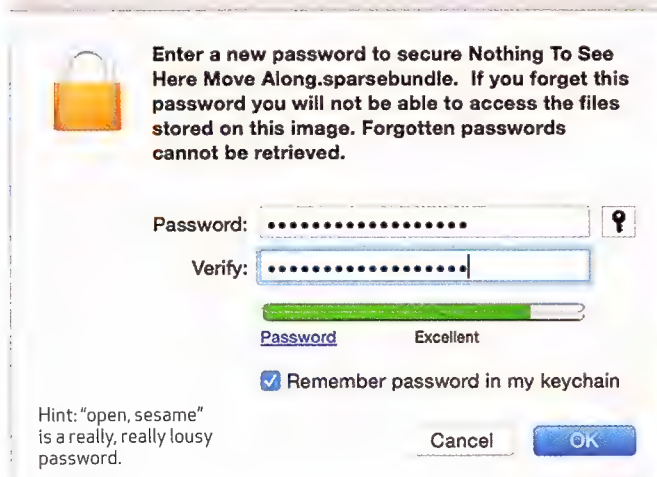
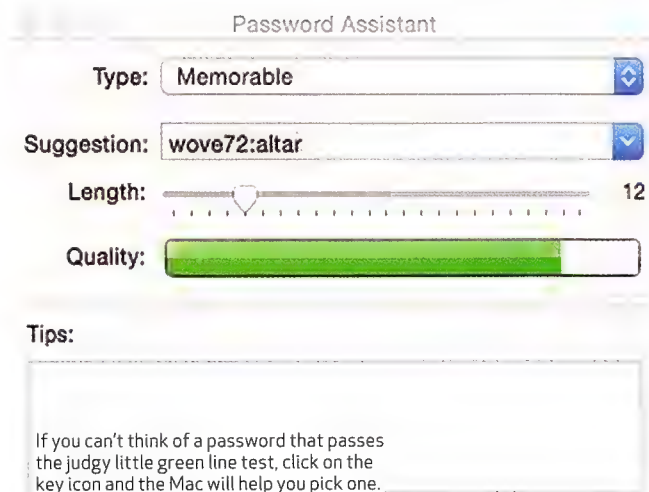
Disk Utility 12 removed the sparse disk image option, replacing it with sparse bundles. Disk Utility 13 (in Yosemite) has restored the ability to create sparse non-bundle disk images for various reasons which space does not permit.

Once you've set those parameters, click on Create. You'll be asked to choose a password, and choose a good one. If you like, click on the key icon next to the password field and OS X's Password Helper will guide you to creating one that's both memorable and safe.

You can choose to save the password to your Keychain or not. If you save it

to your Keychain it's marginally less secure, because if someone knows your Admin password they could recover it from Keychain Manager. If you don't save it to your Keychain it's more secure, but of course if you forget it no-one except maybe the NSA will be able to retrieve your stuff. Your call.

Click OK, and after some buzzing and whirring your disk image will be created and mounted. You won't have to enter your password to start using it straight away, but next time you log into your Mac it will be encrypted and you'll have to enter your password to mount and open it. ■



Track your health with iOS 8

Alan Stonebridge helps you check your stats in Health's dashboard.

People have been using iOS devices to monitor their physical activity for years, mainly with apps that record things manually. Now, though, iOS 8 features a new app that gathers information from various sources – so you don't have to open one app for your digital scales, a different app for your fitness band, another that tracks your cycling and so on, just to get an idea of how you are doing with your health and fitness. Apple's Health app pulls this data together so you can more easily check how well you're doing, rather than putting the burden on you to correlate statistics from various sources and trying to analyse them.

Even if you're uninterested in joining in with the gamification of your health,

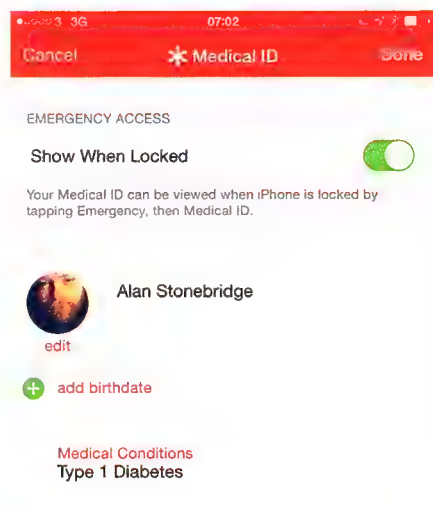
or if you feel you're managing to do just fine without the involvement of technology, Health has another feature that is nonetheless worth setting up. It can create a Medical ID that's accessible from your iPhone's Lock Screen. The idea is that in an emergency, whoever finds you – or the medical professionals looking after you – will have access to your emergency contacts, details of any medical conditions or allergies and any treatments you're taking that might determine the care that's given to you.

Setting up your Medical ID could be a lifesaving act – not just for you, but for someone else if, in the worst of circumstances, your Medical ID confirms that you consent to donate your organs. Let's hope it doesn't come to that quite yet, though!



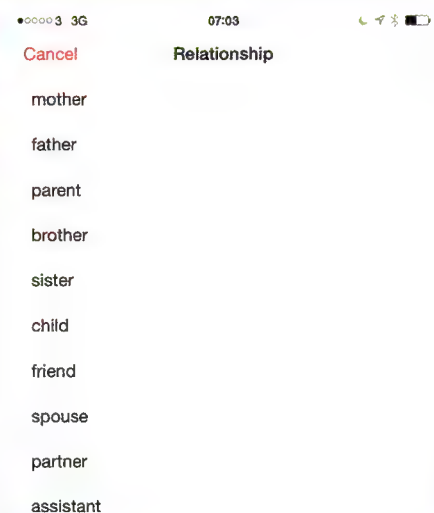
Set up health for use in emergencies

Let your phone give vital information if you can't.



1 SET UP YOUR MEDICAL ID

In the Health app, tap Medical ID in the bottom toolbar, then tap Create Medical ID on the page that appears. This displays a form with places for you to detail your age, facts and statistics about your body, medical conditions you have, medications you take, and whether you are an organ donor. Fill in the form, and leave the Show When Locked switch on if you want this information to be accessible from the Lock Screen should you be found unconscious.



2 EMERGENCY CONTACTS

As well as providing medical details, your Medical ID can also display contact information for anyone who you want to be informed about your situation. You can add many such contacts from the people in your Contacts app. For each one you add, you'll be given the opportunity to define their relationship with you, including parent, sibling, child, friend, colleague, and your own doctor, so that professionals can reach the correct people.

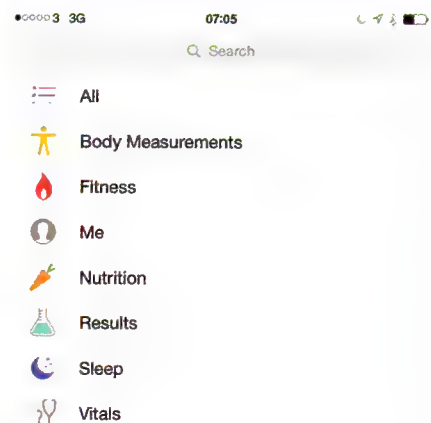


3 HOW TO ACCESS THE ID

Now if someone should find you in an unresponsive state, they can wake your iPhone and slide their finger across its screen to reach the passcode entry screen. Tapping Emergency at the bottom left takes the person to a keypad so they can dial the emergency services, but they'll also see a link that, when tapped, displays the information you added to your Medical ID, including your chosen contacts and potentially life-saving details of your state of health.

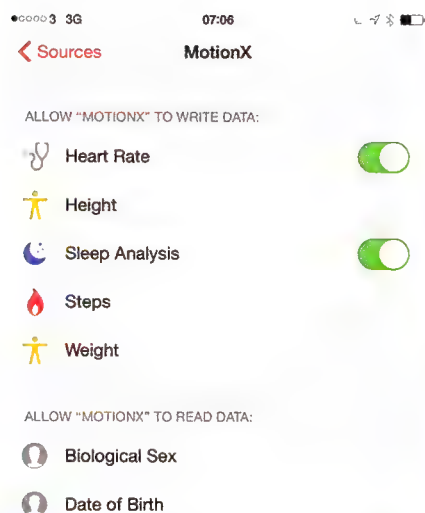
Monitor your day-to-day health

Keep all of your fitness information in the one spot.



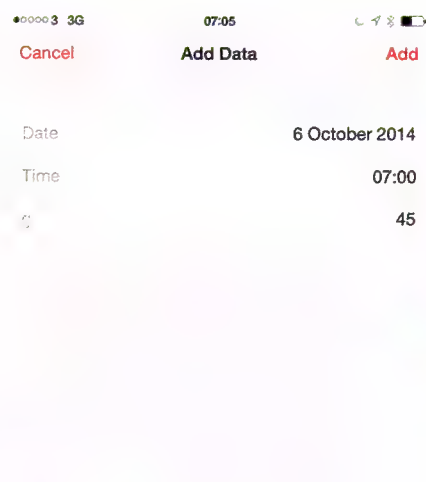
1 THINGS YOU CAN MONITOR

The other items in Health's toolbar can be used to record and review your well-being. Tap Health Data to see items that can be recorded. They include attributes that are common to everyone, such as weight; others that your doctor may want to record because of your age, such as blood pressure and heart rate; and yet more that are used to monitor long-term medical conditions, such as blood glucose levels and how often you use an inhaler.



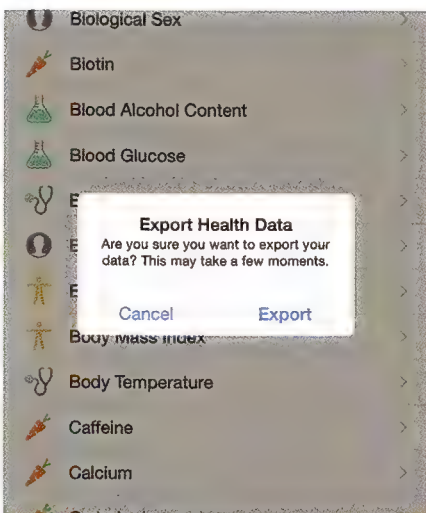
4 OTHER DATA SOURCES

Other apps can supply data to Health. They may use your iPhone's GPS to track, say, cycling distance, or they may connect to a Bluetooth accessory to track your exercise, heart rate, blood pressure and other stats. Apps ask permission to provide data, and you can review which are doing so — and which items each can update — by tapping Sources. Permissions can be rescinded in 'Settings > Privacy > Health', and the Motion Activity and Location Services there.



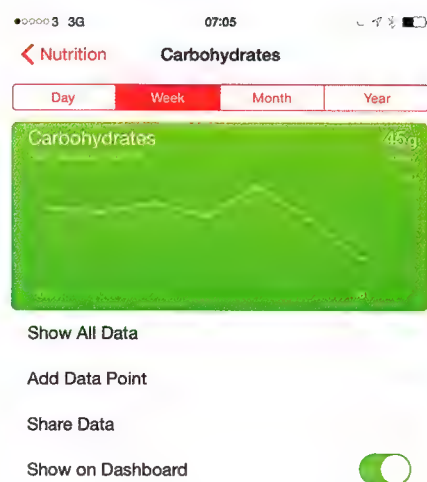
2 RECORD SOME DATA

Tap an item to track and you'll see a graph that's empty for now. Below that, Add Data Point enables you to manually record a reading. Depending on the item type, the form for doing this may indicate an expected scale — right now, you may find it impossible to switch this to the one used in your country. The time and date are automatically set to right now, but this can be overridden in the event that you couldn't add a reading when it was taken.



5 EXPORT HEALTH DATA

Data can be emailed by tapping Health Data, then All, and then the Share button (top right). The archive this creates contains two files structured in a way that isn't easy to read or use without specially-designed software to turn it into a meaningful overview. As Health becomes more widely used, expect more professionals to provide ways to use this data. For now, Health is more useful as a way to review your progress with a professional in person.



3 MANAGE YOUR DATA

Tap Add to return to the overview, where the data point is shown on the graph. Tap Show All Data to review everything in numeric form. Data needn't be added manually. Tap 'Health Data > Fitness > Walking + Running Distance' to see some data captured by your iPhone's sensors. However it was added, data can be removed by tapping Show All Data and swiping leftwards on an item, then tapping Delete, or by tapping Edit and then Clear All.

The Dashboard

Some fitness apps receive data from other hardware, which typically connects to your iPhone using Bluetooth. Among them, the Health Mate app from Withings receives data from several of the company's products, including its Smart Body Analyser, and feeds data into the corresponding items in Health. You may have a blood pressure monitor from one company and a wearable band to track your exercise or sleep patterns from another, and effortlessly use the sensors that you carry around in your iPhone each day to track the findings from both. The data of most interest can be collated in Health's Dashboard, which provides a single place to monitor a multitude of attributes and activity. ■



Build your own Pi OS

You don't have to wait for your Raspberry Pi to boot before tinkering with it — you can create a customised distribution containing just what you want.

In this tutorial, we will explore how to create a customised system image for your Raspberry Pi that contains what you want. You may wish for different packages than those included in the official images, you may wish to customise the configuration, perhaps even customise the kernel. You'll be able to write the image to an SD card to boot your Pi, or you could use an emulator to boot the image on your PC. You can customise an image right on the Pi, but it will be very slow, so we'll also explore ways of using your PC to cross compile or even execute ARM code.

You could, by all means, hack a running system by adding and removing packages but this is risky, because one mistake can stop things working. Also, doing it that way isn't very easy to reproduce, and doesn't provide a suitable candidate for automation.

The first thing we need to do is to fill our tool box. For this tutorial, we'll be using Arch Linux, because this is a great distro that is available for both the PC and the Pi. We'll assume you're running the most recent official Arch Linux image on your Raspberry Pi and that it's up to date. Boot Arch Linux on your Pi and ensure the necessary build tools and other packages are installed:

```
# pacman -Syu
# pacman -S base-devel
python2 git parted dosfstools
```

CHOOSE YOUR OWN ADVENTURE

The first step towards having a customised image is to decide what it should contain. A reasonable selection to start with is Arch Linux's base package group, adding and removing packages as needed. Unwanted kernel packages should be removed and the Raspberry Pi ones added.

It's necessary to build a custom kernel if you need to add features. It can also be useful to disable unwanted kernel features to reduce its size (given the limited memory resources of a computer like the Pi). Given that compiling a kernel natively takes in excess of 10 hours, an alternative method is essential. Using a cross compiler is one way to do that; you can also use distcc, but you still need a cross compiler with distcc because the distcc 'server' has to generate ARM code. We decided to cross-compile the kernel, so both techniques are covered by the tutorial.

The commands below use Pacman, the Arch Linux package manager to get the list of packages in the base group. The unwanted packages are then removed and the Raspberry Pi kernel and firmware ones are added. You can also use your favourite text editor to

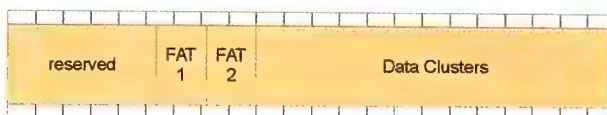
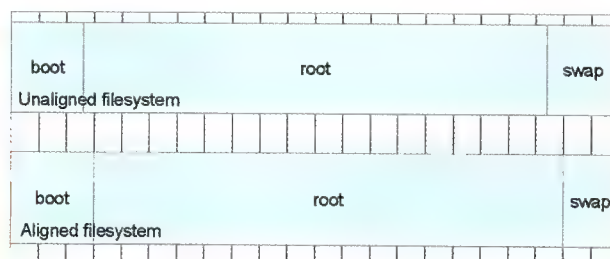
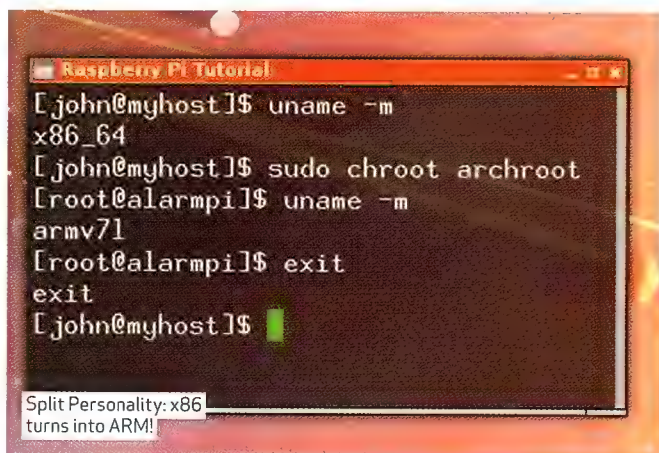
add or remove anything else according to your own requirements (you might want to add openssh).

```
# pacman -Sg base | awk
'{print $2}' | grep -v "^\(linux\|kernel\)" | tr '\n' ' '
> base_packages
# sed -i -e 's/#!/linux-raspberrypi linux-headers-raspberrypi raspberrypi-firmware/' base_packages
```

With the package list decided upon, it's time to install the packages for the new image. The mkarchroot utility makes this easy. It installs packages into a subdirectory that you can then convert into a disc image.

```
# mkarchroot archroot $(cat base_packages)
```

This creates a new subdirectory called archroot that contains everything needed for a complete



Aligning with the erase blocks makes for a happy SD card.

system. You could chroot into this and it would work; in fact, if you wanted to make any changes, for example to set a root password or add user accounts, this is what you would do.

We will create a system image in a file. You could also create it directly on an SD card, but having an image is useful because it can be rewritten to a card quickly or booted in an emulator without ever writing it to a card. The kernel has a loop facility that allows a file to be treated like a physical disk that can be partitioned into filesystems. It creates a regular device node in /dev that is used to access the file in this way.

The image needs to be big enough for the filesystems but small enough to fit on an SD card. We'll create a 2GiB image, the same size as the official image. Ensure the loop kernel module is loaded, create the file and a loop device for it:

```
# modprobe loop
# truncate -s 2G myimage
# device=$(losetup -f)
# losetup $device myimage
```

We use losetup twice — to allocate a device name, usually /dev/loop0, for the loop device, and to create it (we store the device name in a variable so we can refer to it later). The image needs to have a specific partition layout; its first partition must be FAT16 and it must contain the boot files and kernel image. A second partition is required for the root filesystem, and this can be ext4. If you want a swap partition, a third one can be created for that. The Raspberry Pi's boot firmware looks for an MS-DOS-style MBR partition table (unlike the PC BIOS, it doesn't execute a bootloader from the MBR). Use parted to create a partition table on the image file:

```
# parted -s $device mktable
msdos
```

When creating partitions, it is wise to align them with the erase blocks of the target SD card. Doing this is optional but recommended. Most cards have a preferred erase size of 4MiB, but you can check the value (in bytes) for a card:

```
# cat /sys/class/block/
mmcblk0/device/preferred_
erase_size
```

For a 4MiB preferred erase size, alignment occurs every 8,192 sectors (a sector contains 512 bytes, so 4MiB/512). Partitions must therefore start on a sector that is a multiple of 8,192; the first erase block contains the first 8,192 sectors (0..8191) and the second erase block contains the next 8,192 sectors (8192..16383), and so on. Sector 0 is reserved for the partition table, so the first partition needs to start at the next

aligned sector, which is sector 8192. A good size for the boot partition is 40MiB — 81,920 sectors. This is big enough to contain the boot files and ends on an erase block boundary. Create the boot partition starting at sector 8192 and ending on sector 90111 (8192+81920-1):

```
# parted -s $device unit s
mkpart primary fat32 8192
90111
```

Reserve some space for a swap partition if you want one (writing swap on an SD card is questionable due to the slow speed and limited write ability of the medium). As an example, we'll create space for a 256MiB swap partition (this is 524,288 sectors, or 64 write blocks).

Our 2GiB image contains 4,194,304 sectors (2GiB/512 = 4,194,304). Recalling that sector numbering starts at 0, that makes the last sector 4194303. The root partition can use all the space between the boot and swap partitions, starting at aligned sector 90112 and ending at an alignment boundary, leaving 256MiB for the swap partition. Create them:

```
# parted $device unit s
mkpart primary ext2 90112
3670015
# parted $device unit s
mkpart primary linux-swaps
3670016 4194303
```

Should you wish, you can print out the partition table with parted -s \$device unit s print. Next, create the filesystems. The loop device needs to be recreated so that device nodes are created for the partitions (the -P option does this):

```
# losetup -d $device
# device=$(losetup -f)
# losetup -P $device myimage
```

Consider aligning the filesystems' internal structure. Aligning a FAT filesystem requires knowledge of its FAT size. You have to make a filesystem to find this out:

```
mkfs.vfat -I -F 16 -n boot -s
16 -v ${device}p1 | grep "FAT
size"
```

The structure of a FAT filesystem is shown in the diagram. To achieve alignment, adjust the reserved space so that the beginning of the data area is aligned. This size of the reserved space needs to equal the preferred erase size, less the size of the two file allocation tables. Continuing our example with a FAT size of 32 sectors, the reserved space would be 8,192-(2*32)=8,128 sectors. Make the filesystem again using this information:

Work in your image with chroot

Sometimes it's useful to work inside a filesystem image, such as the archroot that we created in this tutorial. You can use chroot to do this, but it helps to bind-mount some parts of the filesystem first. Here is a little script you can use to enter a chroot:

```
#!/bin/bash
mkdir -p $1/{dev/
pts,proc}
mount proc -t proc $1/
proc
mount devpts -t devpts
$1/dev/pts
chroot $1 /usr/bin/env
-i
TERM="$TERM" /bin/bash
--login
umount $1/{dev/pts,proc}
```

```
mkfs.vfat -I -F 16 -n boot -s
16 -R 8128 -v ${device}p1
```

For the root partition, use an ext4 filesystem. This aligns with the erase size due to its 4KiB block size. Create it without journalling, as this reduces writes to the SD card:

```
# mkfs.ext4 -O ^has_journal
-L root ${device}p2
```

Mount the filesystems and copy the files from the archroot subdirectory into place. The boot partition is mounted at /boot on the root partition so that the boot files get placed on the correct partition:

```
# mount ${device}p2 /mnt
# mkdir /mnt/boot
# mount ${device}p1 /mnt/boot
# (cd archroot ; cp -a * /
mnt)
# umount /mnt/boot /mnt
```

Now, write the image to the SD card (if your Pi has its root filesystem on the SD card, you'll need to copy the image to another machine with a card reader):

```
# dd if=myimage of=/dev/
mmcblk0 bs=4M
```

Shut down your Pi, pop in the new card and boot up. Alternatively, copy your image on to your PC and use an emulator to run it there.

The linux-raspberry package that we included in our image contains the official kernel image, but it is quite straightforward to customise it. You



need the kernel source code and a compiler to convert that into the executable kernel image. A compiler normally produces executable code for the same CPU but, by using a cross compiler, it's possible to produce executables for different CPUs.

With a cross compiler, we can take advantage of our more powerful x86 hardware to compile for the Raspberry Pi's ARM hardware much quicker than we could do it directly on the Pi (compiling the 3.2.27 kernel on the Pi takes hours; with a cross compiler, an Intel i7 can do it in two and a half minutes). So leave your Pi to one side for a moment and get ready to compile on your PC. The native compiler is called gcc and the cross compiler version for the ARM architecture is called arm-linux-gnueabi-gcc. It isn't in the repositories, but building it is simple if you use yaourt (yet another user repository tool):

```
yaourt -S arm-linux-gnueabi-gcc
```

You'll need stay close to your terminal so you can answer yaourt's many prompts (choose 'no' when asked if you want to edit the PKGBUILD and 'yes' when asked if you want to build or install a package. It builds in stages, so also choose 'yes' to replace conflicting packages).

HELLO WORLD!

Before going further, it's probably worth checking your cross compiler. In true programmer fashion, we'll do a quick 'hello, world'. Create a new file called hello.c:

Make your image on your PC

With emulation, you can use mkarchroot to create the archroot subdirectory on your PC instead of on your Pi. You will need to configure the package manager so it downloads ARM packages and also patch mkarchroot (it is a Bash script) so it installs qemu-arm-static into the archroot when it creates it. With this final piece of the puzzle, you can build a complete image for your Pi, along with customised kernel and other packages, on your PC.

```
#include <stdio.h>
int main ()
{
    printf("Hello, World!\n");
    return 0;
}
```

Now compile it for ARM and check its type is correct:

```
# arm-linux-gnueabi-gcc -o
hello hello.c
# file hello
hello: ELF 32-bit LSB
executable, ARM, version 1
(SYSV), dynamically linked
(uses shared libs), for GNU/
Linux 2.6.27, not stripped
```

If you copy the 'hello' file over to your Pi, you should be able to execute it:

```
$ ./hello
Hello, World!
```

With that success, we have a cross compiler, and we can get on with compiling our custom kernel.

```
$ git clone --depth 1 git://
github.com/raspberrypi/linux-
git
$ cd linux
$ ssh root@alarmpi zcat /
proc/config.gz > .config
$ make -j 8 ARCH=arm CROSS_
COMPILE=arm-linux-gnueabi-
menuconfig -k
```

We download the kernel source from github. Using --depth 1 just gets that latest version and not the entire history; it's much quicker this way. We then copy the Raspberry Pi's current kernel configuration into a file called .config and open that file in the kernel menuconfig editor. This is where you can customise the kernel configuration to meet any specific requirements that you may have. Exit menuconfig when done, opting to save the updated .config. You're now ready to build the kernel and its modules (which we install to a subdirectory):

```
$ make -j 8 ARCH=arm CROSS_
COMPILE=arm-linux-gnueabi- -k
$ mkdir -p modules
$ make -j 8 -k ARCH=arm
CROSS_COMPILE=arm-linux-
gnueabi- modules_install
INSTALL_MOD_PATH=modules
```

When the build finishes, you could upload the new kernel image and modules to the Pi and then reboot it (you may want to back up the old kernel and modules directories first):

```
$ scp arch/arm/boot/Image
root@alarmpi:/boot/kernel.img
$ cd modules/lib/modules
$ tar cdf - * | ssh root@
alarmpi '(cd /usr/lib/modules;
tar xjf -)'
```

```
$ ssh root@alarmpi reboot
```

Alternatively, you can install it into your archroot tree prior to creating an image. Copy arch/arm/boot/Image to archroot/boot/kernel.img and copy modules/lib/modules to archroot/usr/lib.

EMULATOR TOO

You can also use your image with an ARM emulator to run a virtual Raspberry Pi on your x86 PC. QEMU is a processor emulator that can run ARM code on your x86-based PC, and pacman -S qemu will install it. Create a directory and copy your image there. You'll also need a custom kernel image designed for the emulator. A suitable

kernel (kernel-qemu) is provided at www.apcmag.com/magstuff – copy that to the same place as your image. Now you can run an emulator with:

```
qemu-system-arm -machine
versatilepb -cpu arm117b -m
256 \
-no-reboot
-serial stdio -kernel kernel-
qemu \
-append
"root=/dev/sda2 panic=1" -hda
myimage
```

There is another trick we can perform with an emulator: we can execute ARM code from our x86 command line. This is called transparent emulation, and it uses a kernel feature called binfmt-misc to invoke any ARM executable inside QEMU. But to achieve this, there are hoops to jump through.

First, you need to have access to /proc/sys/fs/binfmt_misc. If you don't have it, then you can mount it:

```
# mount binfmt_misc -t
binfmt_misc /proc/sys/fs/
binfmt_misc
```

You then need to register the ARM binary format with the kernel. This tells it how to recognise them and what it should do with them. Recognition is based on pattern matching at the beginning of the file. To register ARM executables:

```
echo ':arm:M::\x7fELF\x01\
\x01\x01\x00\x00\x00\x00\x00\
\x00\x00\x00\x00\x02\x00\x28\
\x00:\xff\xff\xff\xff\xff\xff\
\xff\x00\xff\xff\xff\xff\xff\
\xff\xff\xff\xff\xff\xff:/' > /
proc/sys/fs/binfmt_misc/
register
```

With that in place, any attempt to execute an ARM binary will result in /usr/bin/qemu-arm-static being executed instead. It is passed the ARM binary's path as a parameter. The result is that QEMU executes the ARM binary transparently. Putting /usr/bin/qemu-arm-static inside your image tree will allow you to chroot into it but, for this to work, we need a version of QEMU that does not rely on shared libraries, because there are only ARM libraries inside the chroot. This is what qemu-arm-static is for. Unfortunately, few distributions provide a statically-linked QEMU, so you will have to build it yourself. A pre-built one for x86-64, along with details of how to build it, are in the tutorial archive. Install it as /usr/bin/qemu-arm-static.

Now, if you place qemu-arm-static on the x86 host at /usr/bin and also inside your archroot subdirectory at archroot/

usr/bin, you should be able to chroot into that ARM filesystem. Once there you could, for example, use pacman to install further packages.

Although it's straightforward to build and execute ARM code on the x86 using these techniques, things can get sticky if you need to build packages, because this introduces dependencies into the mix. In a cross-CPU environment, that can be a problem because the makepkg tool expects its dependencies to be installed, and you can't install ARM dependencies on to x86. The easiest way to use your x86 horsepower to build for the ARM CPU is to use a tool called distcc that allows you to build on your Pi, but have it delegate its compile tasks to one or more distributed clients that have more power. With distcc in place, using makepkg to build packages on your Pi will allow it to transparently make use of your x86 box's power for its compiling tasks.

To use distcc you have to install it on both your Raspberry Pi and your desktop. The command is the same in both places: pacman -S distcc. The Pi is the client and controls the builds; you run makepkg on the Pi. The only configuration required on the client is to set up makepkg to use distcc. Edit /etc/makepkg.conf with the details of your distcc server:

```
BUILDBENV=(fakeroot distcc
color !ccache)
DISTCC_HOSTS="10.0.200.12"
MAKEFLAGS="-j8"
```

Your PC is the server and makes itself available to perform compiler tasks. Configuration requires specifying the hosts that are allowed to connect; this is done in /etc/conf.d/distccd. The server should be started as a daemon (this can also be automated at boot time):

```
/etc/rc.d/distccd start
```

With the client and server configured, running makepkg on the client (the Pi) will run the compile jobs on the server. There is one more configuration that is needed so that the server's distccd can find the correct compiler: the compiler we want is called arm-linux-gnueabi-gcc but distcc will look for gcc, which is the native x86 compiler. To fix this, create a symbolic link and modify the path for distccd:

```
# ln -s /usr/bin/arm-linux-
gnueabi/gcc /usr/bin/arm-linux-
gnueabi-gcc
# sed -i -e '/^PID=/iPATH=/
usr/bin/arm-linux-
gnueabi:\$PATH' /etc/rc.d/
distcc
```

It's a good idea to set symbolic links for the whole toolchain. You can get the

Raspberry Pi boot sequence

The Raspberry Pi does not boot the same as a PC. It is the GPU on the Pi that starts the process (not the ARM chip, as you may assume). After power-on, the GPU runs its first-stage bootloader (ROM firmware). This loads further stages from the first (FAT16 formatted) partition on the SD card. The second-stage bootloader, called bootcode.bin, is loaded and executed in the GPU's L2 cache.

This, in turn, loads a third-stage bootloader, called loader.bin in RAM, which reads the GPU firmware, called start.elf. Additional files config.txt and cmdline.txt allow configuration of this boot process. Finally, start.elf loads the Linux kernel image, named kernel.img, into the ARM processor's RAM space and the ARM processor is enabled. This starts executing that image and the standard Linux boot process follows thereafter.

The traditional master boot record (MBR, sector 0) of the SD card only contains the partition table information. Unlike on a standard PC, no MBR code is executed.

script to do this from www.apcmag.com/magstuff.

UPROOTING

While having all this custom image fun, you may decide that the SD card is not the best place for your root filesystem. It's quite straightforward to move your root partition to another device, such as a USB hard drive. All you need to do is copy the existing root filesystem from the SD card on to a partition on the USB hard drive, resizing it if appropriate:

```
# dd if=/dev/mmcblk0p2 of=/
dev/sda1 bs=4M
# fsck /dev/sda1
# resize2fs /dev/sda1
```

Edit /boot/cmdline.txt to change the location of the root partition in the boot command. Change the root=/dev/mmcblk0p2 to root=/dev/sda1. Now reboot and your root partition will be on the hard disk. This requires your kernel to have the relevant USB drivers compiled in. The standard one does, so this should not be a problem. ■



Root access can be gained on a Google Chromecast, but only on new-in-box units.

Hacking Google's Chromecast

It's the companion device to Android allowing content streaming and screen casting to your TV. But as Darren Yates reports, there's more to it than meets the eye.

It may have taken Google a year or so to decide Australia was ripe for its tiny online streaming media player, but Chromecast has become a popular addition to the local Android market. The device itself is wrapped up tightly in a web of Google firmware updates, but in the last few months, it's been giving up its secrets as users gain root access and ultimate control of the device.

WHAT'S INSIDE?

We've been talking about Android mini PCs in APC since September 2012, just after they began arriving on the market, these tiny USB stick-sized

Android-OS computers running low-power ARM-class CPUs. Essentially, Chromecast is just a custom mini PC – a Marvell 88DE3005 single-core CPU with 512MB of RAM, 2GB of flash storage and 2.4GHz 802.11b/g/n Wi-Fi combined with a cut-down Chrome operating system.

WHY HACK IT?

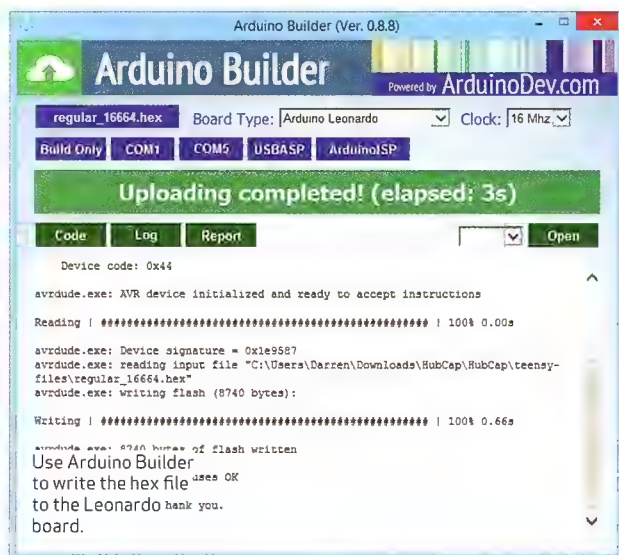
Chromecast is easy to set up – you plug it into an HDMI-ready TV or monitor, power it up with the provided brick and run through the setup procedure using the Chromecast app from Google Play on your Android device.

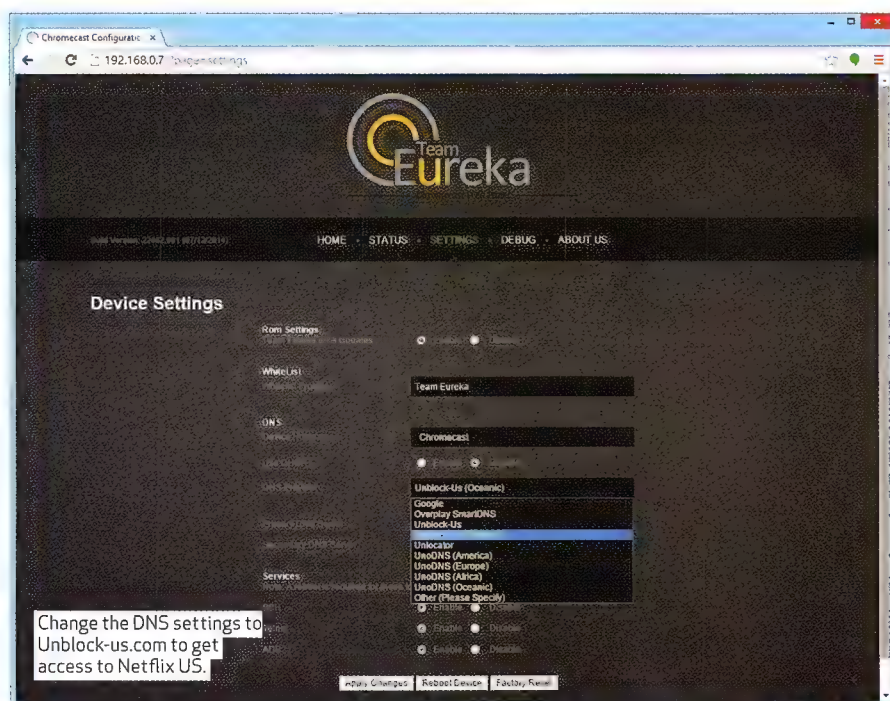
However, in most cases, doing so also

locks off the ability to get inside and gain root access. Why do you want 'root'? For starters, it enables you to change the DNS settings directly, allowing access to Netflix US and other geo-blocked online video streaming services rather than just the local Australian ones. But as soon as you setup your Chromecast dongle, the first thing it does is 'phone home' for the latest firmware update, which Google quickly ensures breaks any vectors used to enable root access.

CAN IT BE HACKED?

The main factor determining if your Chromecast dongle can be hacked is





the version of its on-board firmware. At time of writing, the key number was '19084'. If your unit has that version or later, it currently cannot be hacked – since Chromecast auto-updates, you're almost always guaranteed to have the latest firmware.

That means you can typically only hack a brand-new still-in-box Chromecast, so the trick is buy your Chromecast – and do nothing it. Seriously, you must find out that firmware version number and for that, the first thing you should do (after installing the Chromecast app on your Android device) is pull the phone line from the back of your wireless modem/router before you power up the dongle. If you allow Chromecast to setup with the internet connected, it'll phone home faster than you can say 'NBN' and update the firmware. By the time you're aware that it's updated, it's too late.

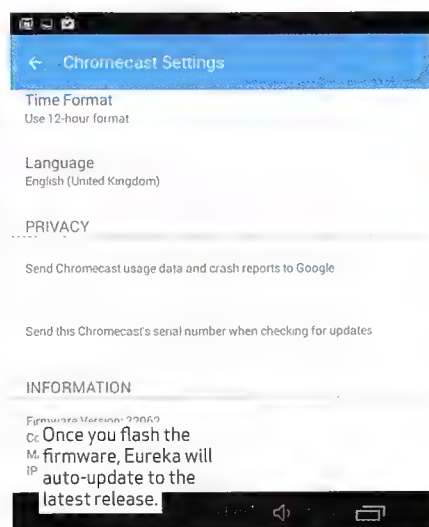
We purchased our Chromecast unit just before Christmas last year from JB Hi-Fi's Penrith NSW store, ran it through the setup (without web access) and found from the Chromecast app's settings page the firmware number '15098'. Since that's less than 19084, it can still be hacked.

THE HACK PROCESS

Gaining control of your Chromecast is a reasonably complex process and isn't for newbies – it requires quite a deal more work than just rooting your typical Android device, mainly because Chromecast is much harder to hack. As a result, the 'HubCap' process is involved and needs the help of a small external microcontroller board to first boot the Chromecast dongle into a

recovery-like mode, before a USB flash drive can be connected with the FlashCast modding software and replacement Eureka ROM. The microcontroller board usually recommended is a Teensy 2 or 2++, which sell for around \$20 and are only available from one source, but there is an alternative method using an Arduino Leonardo board you can buy from eBay for closer to \$9, which includes shipping.

Those of you who follow my Arduino Masterclass each month will have greater familiarity with Arduino, but for newbies, Arduino is a series of microcontroller (CPU + RAM + flash storage) board you code to make your own projects from robots to quadcopters and more. The Arduino Leonardo is a newer version of the Arduino Uno R3 board we typically use, running a different chip – the



Sources & warning

If you're after more info, try:

XDA Developers' Chromecast Hubcap root forum

<http://tinyurl.com/xdahubcap>.

XDA Developers' Eureka ROM forum

<http://tinyurl.com/eurekarom>.

This is an advanced hack and not recommended for beginners. The information in this article is provided as-is, without warranty. We have tested it successfully on our own Chromecast dongle, but you use it at your own risk.

ATMEGA32U4, which has a built-in USB controller (like the Teensy 2/2++).

GETTING POWER

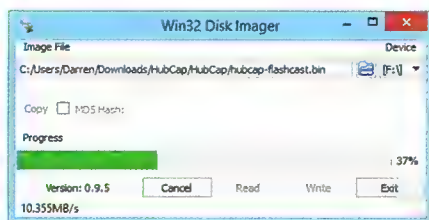
Making things more complicated, you need to connect the Arduino Leonardo board directly to the Chromecast dongle, both of which have microUSB ports – but you also have to power the two through those ports and you can't use a USB hub.

The commonly quoted option is to use a USB splitter cable with a female Type A connector on one end, a male microUSB and female microUSB connectors on the other. You can then use a standard smartphone cable and USB-OTG cables to connect up the various components when required. These can usually be found on eBay for under \$2 each, including shipping.

We didn't use this exact splitter but ultimately, it doesn't matter which method of cabling you use, as long as you end up with a USB Type A male connector to plug into power and a cable link with two microUSB male connectors to go into the two devices.



A Type A to microUSB male and female USB splitter cable will work well.



Win32DiskImager can write the HubCap firmware to your USB flash drive.

DOWNLOADS

Here's a list of downloads you'll need for this hack:

- Arduino Builder: sourceforge.net/projects/arduinoide/files/ArduinoBuilder/ArduinoBuilder-0.8.8.7z/download
- Arduino IDE: arduino.cc/download.php?f=arduino-1.0.6-windows.exe
- HubCap root firmware: download.gtvhacker.com/file/chromecast/HubCap.zip
- Win32DiskImager: sourceforge.net/projects/win32diskimager/files/latest/download

THE STEPS

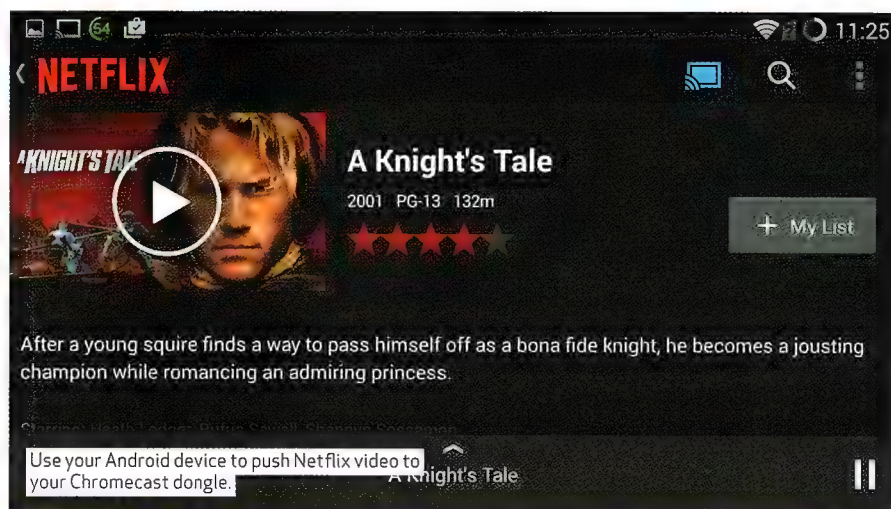
There's also a list of steps required to get this working:

- Write the launch hex file to the Arduino Leonardo
- Write the FlashCast/Eureka ROM firmware to a USB flash drive
- Use the Arduino Leonardo to trigger the Chromecast dongle into recovery mode
- Flash Chromecast with the new Eureka ROM from the USB flash drive

And this must all be done before allowing Chromecast to see the internet.

STEP 1: FLASH HEX FILE TO: ARDUINO LEONARDO

Get hold of an Arduino Leonardo board, connect it to your PC, launch the Arduino IDE and from the top menu, select Tools/Serial Port and look for the COM port number (it won't be COM1, that's your mouse). Now launch Arduino Builder, click on the Load



"WARNING — this process erases the flash drive and reduces its capacity to the size of the image file."

Sketch/Hex button, navigate to the unzipped HubCap folder, search through the teensy-files subfolder for the file regular_16664.hex and select it. Next, change the Board Type to 'Arduino Leonardo' and click on the COM button that matches the number you noted from the Arduino IDE. This will flash the hex file to the Arduino Leonardo board.

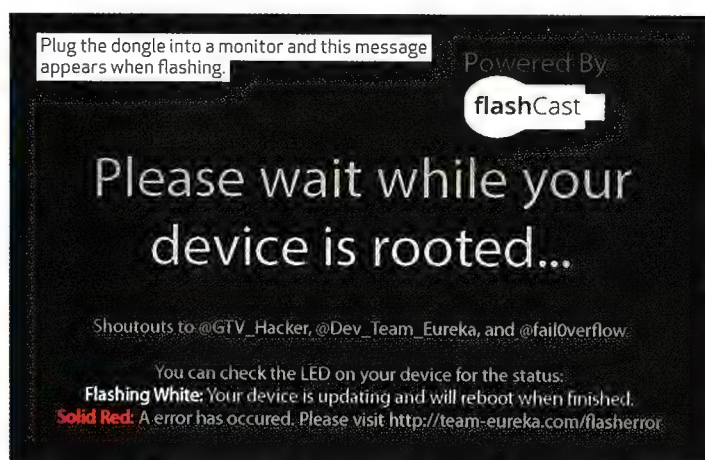
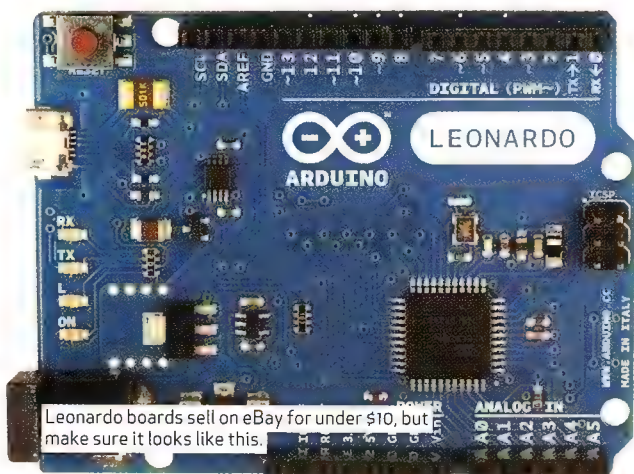
(NOTE: This reprograms the Leonardo board and will no longer be recognised by Windows, so get it right the first time. It can be reprogrammed back to original, but requires an Arduino Uno board or AVR programmer and some jumper wires. Learn more at arduino.cc/en/Tutorial/ArduinoISP.)

STEP 2: WRITE FIRMWARE TO THE FLASH DRIVE

Next, we need to write the FlashCast/Eureka ROM firmware to a USB flash drive. It must be written like an ISO image, requiring Win32DiskImager for

the job. WARNING — this process erases the flash drive and reduces its capacity to the size of the image file (about 130MB) — you only need a 1GB flash drive, so use an old one you have lying around. The capacity can be restored but needs a Linux system with the Gparted utility.

Plug the USB flash drive into your PC, install Win32DiskImager and launch it. Click the folder icon (browse) button towards the top right of the app window to bring up the 'Select a disk image' window. Change the 'file type' dropdown box from 'Disk Images (*.img)' to '*.*'. Now navigate to your HubCap folder and select the hubcap-flashcast.bin file. Win32DiskImager should only pick up your externally-connected drives, but make sure you have the right drive letter selected — the app will overwrite the drive you select, erasing it, so be warned. When ready, press the Write button. The writing process should only take less than a minute.



STEP 3: CONNECT THE ARDUINO LEONARDO TO CHROMECAST

The first thing here you must do is disconnect the phone cable from your wireless modem/router – you don't want newly-opened Chromecast getting access to the internet to update the firmware.

Now how you connect the Leonardo board to the Chromecast is up to you, but again, the rules are no hubs (direct cable link only) and you must provide USB power. Ultimately, you want a USB type A connector at one point of the cable and two microUSB male connectors to connect to the Arduino Leonardo and the Chromecast dongle.

Start by plugging in the Leonardo board into the cable and plug in the Type A connector into the USB AC power adapter. When you see the green power LED on the Leonardo, press its reset button at the top corner. The Leonardo orange LED will start pulsating – wait until it stops, then while holding down the Chromecast button, plug it into the other MicroUSB connector. The Chromecast LED will start white, then quickly go red – when you see red, let go of the button. After about 30 seconds or so, the Chromecast LED will go white again. At that point, you can remove the Arduino Leonardo board but keep the power applied to the Chromecast dongle. If you don't get a white LED on Chromecast, try this step again.

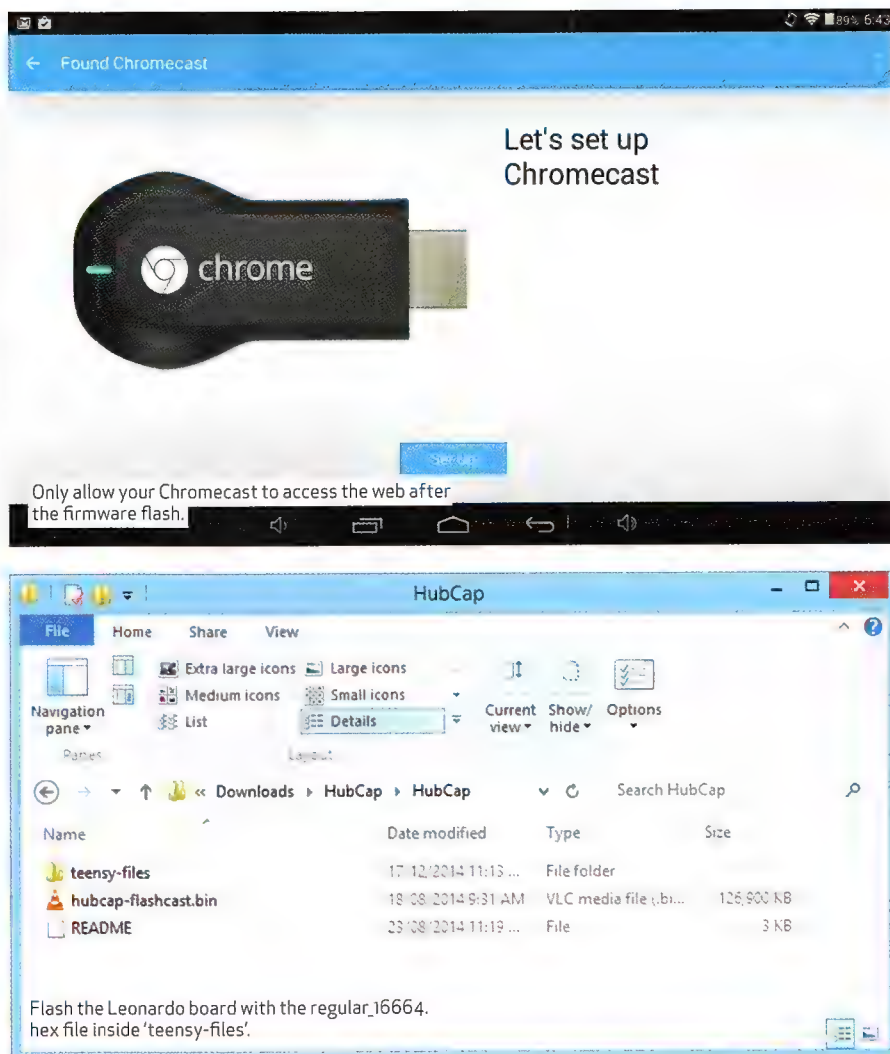
STEP 4: CONNECT THE USB FLASH DRIVE TO CHROMECAST

Grab the USB flash drive with the Eureka ROM firmware you created in Step 2. Plug it into the cable mix and press the Chromecast button. It'll instantly go from white to red and, if you have the Chromecast dongle plugged into a monitor, you'll get the FlashCast splash screen. It'll take a few minutes and reboot when complete. Once that's done, you're done – plug the phone line back into your modem and you're away.

At time of writing, the current HubCap firmware pack installed version 17977 into Chromecast, but the new ROM also includes OTA updates from Team Eureka to newer versions of the ROM and within a few minutes, it'll grab the latest release (22062 at time of writing), update and request a reboot. When you've done that, you've got a rooted Chromecast ready to go.

EUREKA WEB INTERFACE

One of the ROM's best features is the web-based control panel. Just fire up your web browser and head to the Chromecast IP address – you can find this by launching the Chromecast app on your Android device, looking for the Chromecast dongle, selecting Settings in the app and scrolling down until you



see the IP address. Type that into your browser address bar and you'll get the web interface. For example, ours sat on 192.168.0.7.

WATCHING NETFLIX US

The prize for all of this work is accessing Netflix US via Chromecast, something you can't do directly without root access. The reason is that Google locks Chromecast to use only its own domain name server addresses. Eureka ROM unlocks the DNS settings and lets you set them to whatever. What's more, the web interface gives you quick-connect options to DNS providers such as **Unblock-us.com**, which we've talked about before. Just click inside the black text box next to 'DNS provider' and choose your option. Click 'apply changes' and you're done.

All you do now, if you haven't already, is to sign up to a DNS rerouter service such as **Unblock-us.com**, get the Netflix app onto your Android device and sign up for an account. We've covered this process before – read it on the APC web site at apcmag.com/how-to-use-android-to-watch-netflix-australia.htm.

Once you're set up, you use the Chromecast cast button on your Android device's Netflix app to trigger Chromecast to install and launch the Netflix app on the dongle itself – from there, it takes over and your Android device becomes the remote control.

IS IT WORTH IT?

With Google now allowing screen casting to Chromecast from more devices with KitKat/Android 4.4.2 or newer, plus new guest mode on stock firmware, you could easily argue this hack is a lot of effort just to get Netflix US action on a Chromecast dongle. At present, once you hack your Chromecast, there's no clear way to get back to stock firmware, plus, you need a brand-new Chromecast dongle to do this anyway, so they're all things to think about before you commit.

But if you can't get enough of Netflix US, or even if you just don't like locked-up devices, almost anything can be hacked these days – including Chromecast. ■

Arduino Basics #5 – Add SD storage to Arduino

Don't settle for just 32KB of storage. Get up to 32GB for your Arduino projects from a tiny \$2 MicroSD card reader. Darren Yates explains how.

Arduino Uno's microcontroller board is great, but the one thing it's not overly generous with is storage. Having 32KB of program flash storage, 2KB of RAM and 1KB of programmable EEPROM space at your disposal is fine for many Arduino projects, but it's not enough when you need to record data. But with a \$2 microSD card reader module from eBay, you can quickly add up to 32GB of space. What's more, FAT32 software libraries for Arduino mean you can also load the card back into your PC.

MICROSD CARD READER

Not much larger than a full-size SD card, these new low-cost MicroSD card readers take care of translating the 5V digital signals from the Arduino into 3.3V signals microSD cards require. What's key is that the reader uses the Arduino's Serial Peripheral Interface (SPI) port. SPI is a low-speed low-power serial interface common to microcontroller chips like the ATMEGA328P found on most Arduino Uno boards – but fast enough to handle data transfer at reasonable speed.

The reader we're using has only six pins, four for data and two for power, so it won't chew up too many I/O pins from your projects. What's great about it is that it can read and write data, plus the software libraries are easy to use.

CONNECTIONS ALWAYS CONNECTIONS

But because the card reader requires the Arduino's SPI, it does mean you must use certain I/O pins that are connected to the SPI bus to make it work. Apart from the Vcc and GND pins which must go to the Arduino's 5V and GND pins respectively, you need to connect D10 to the CS pin on the microSD module, D11 to MOSI, D12 to the MISO pin and D13 to SCK. Once that's done, you're ready to hit the Arduino IDE and begin coding.

SIMPLE WEATHER MONITOR

If you live near Australia's eastern seaboard, you'll remember the recent spate of stormy conditions, which saw temperature and humidity go up and down like a yo-yo every day for a couple of weeks. You can make a very simple

weather logger using a temperature/humidity sensor and our microSD module. We've discussed the low-cost DHT11 sensor previously, but this time, we've upped it to the DHT22, available on eBay for around \$5 including shipping. It's also known as the AM2302 and while it has the same four pins as the cheaper DHT11, it has a greater accuracy and can measure temperatures from -40 to +80-degreesC and humidity from 0 to 100%.

Again, we're incorporating the Arduino protoshield from last month, but you can use any standard breadboard. The circuit diagram and overlay diagram here will give you all the details you need to building the project yourself.

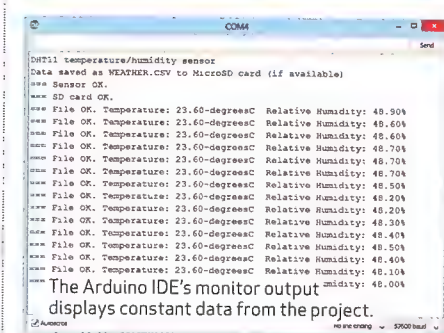
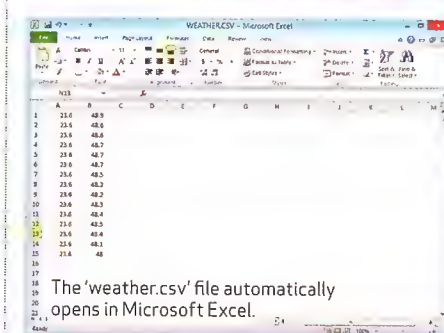
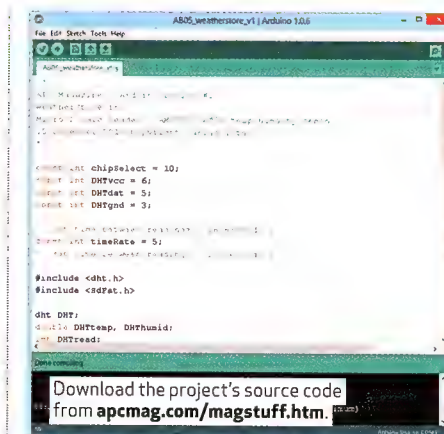
READING, WRITING, ARITHMETIC

To get both of these devices talking with the Arduino Uno, you need two libraries – SdFat and dht. We've included them in the project zip file this month at www.apcmag.com/magstuff, so just copy the contents of the /libraries subfolder into the same in your Arduino IDE folder, then restart the IDE and load in the .ino source file.

We've purposely kept our 'WeatherStore' project simple, so that you can get a handle on how the code works. Basically, there are two tasks running – reading the DHT22 sensor for temperature and humidity; and writing that data to a microSD card every five seconds. The 'five seconds' is arbitrary, you can change it in the code.

There are two main methods or procedures in our code – setup() and loop(). Like all Arduino code, the setup() runs once right at the start, then loop() takes over and runs until the power is removed. In our code, the setup() routine is used to initialise the sensor and the microSD reader – the code leaves basic information on the serial monitor (magnifying glass icon top-right of the Arduino IDE).

The loop() method takes over and captures readings every five seconds by default – it begins by opening up the WEATHER.CSV file, locating the end of the file, capturing the sensor readings, appends those readings as pairs using a comma delimiter to the end of the file

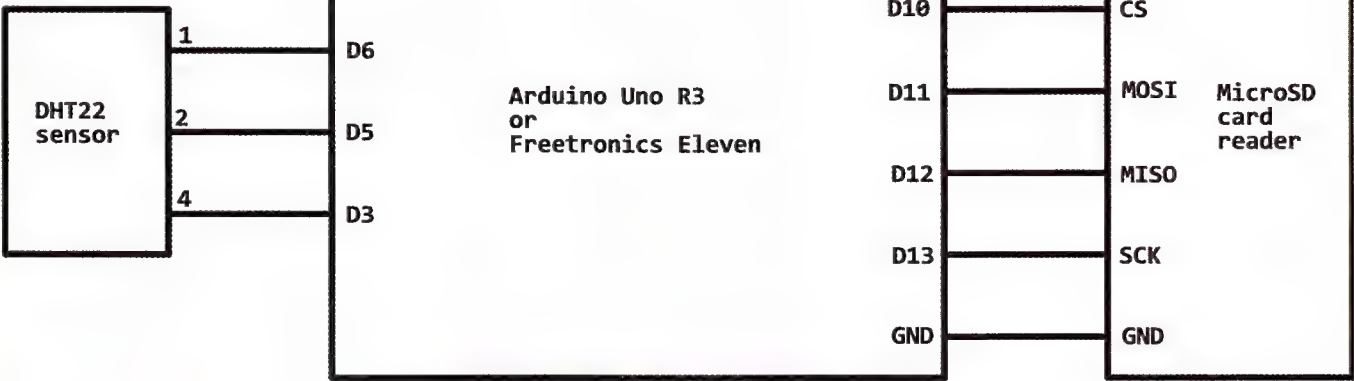


and closes it again. This constant opening and closing might seem a bit dopey but there's a reason – by closing the file when it's not in use, it should survive having the power randomly removed (whether intentionally or accidentally). If we left the file open, a loss of power may corrupt it.

The benefits of using a comma-separated variable (CSV) format are that it's easy to write on an Arduino-powered project, but also easily opened as an Excel spreadsheet.

One final thing, look at the logFile.

The circuit diagram of our WeatherStore project this month.



The WeatherStore combines an Arduino Uno with a DHT22 sensor and microSD reader.

open command in the loop() method and you'll see the OATEND flag at the end – this tells the Arduino to open the WEATHER.CSV and append the new reading to the end. It shouldn't erase previous data, but we recommend making copies of previous data before starting the WeatherStore again.

SCIENCE PROJECT

Another option you could add to this project is a real-time clock (RTC) module to allow you to write the current time to the file as well. Still, if you just note the time you power up the WeatherStore, you can track the readings with sufficient accuracy.

Because there's no soldering involved, this would be a great project for a high-school science or technology class, allowing you to carry out experiments and log changes in environment temperature and humidity over time. The project consumes around 40mA of current, which would still give around two days' continuous monitoring from a set of 2000mAh NiMH batteries or about 12 hours from a 9V Energizer battery.

That gives scope for plenty of questions to answer:

- Are temperature and humidity related? If so, how?
- What general temperature and humidity conditions create severe fire weather?

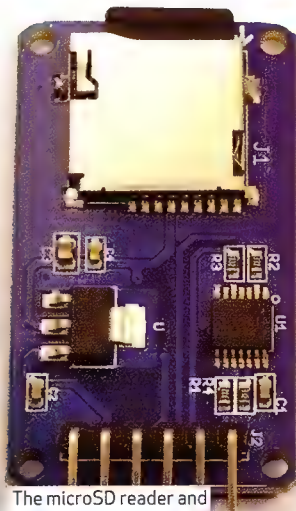
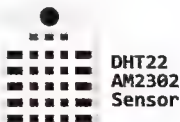
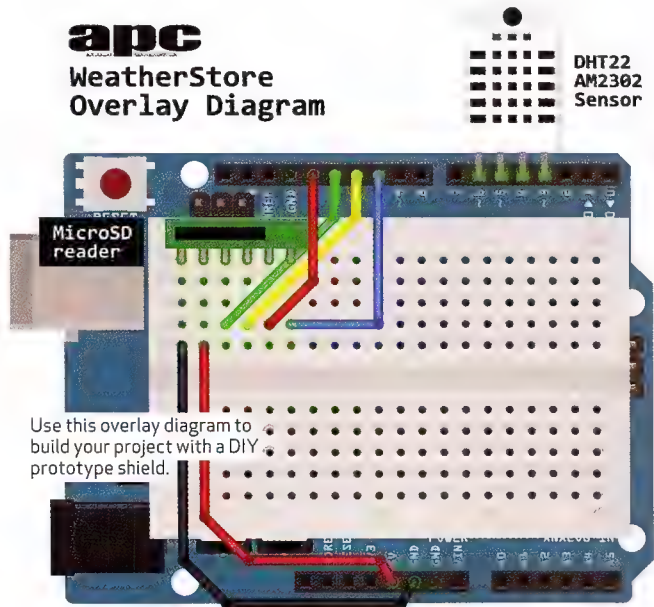
■ In cold climates, does humidity change when temperature reaches 0-degreesC?

Obviously, this is just one example of how you can use microSD card storage in your projects. However, the fact you can use FAT32-formatted storage makes it easy to transfer files from an Arduino to your other devices. ■

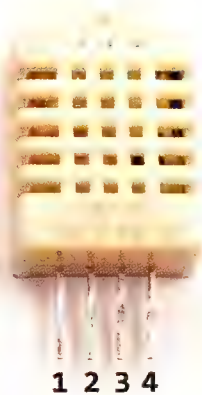
Main components

- Arduino Uno R3 or Freetronics Eleven microcontroller board (tinyurl.com/nueobxw)
- DHT22/AM2302 temperature-humidity sensor (tinyurl.com/kdgpl8v)
- MicroSD card reader (tinyurl.com/ljqeebt)
- DIY Prototype shield or generic breadboard (tinyurl.com/mtfgm9l)

apc WeatherStore Overlay Diagram



The microSD reader and DHT22 sensor are the external components.





Know your Arduino

Arduino began as a humble educational device but has grown into a global phenomenon. Everywhere you look you can find it as the foundation for projects ranging from the simplest prototype to the most advanced Internet connected device.

With a wide variety of Arduino compatible boards available, along with expansion "shields" that add new features and a huge range of modules including sensors and output drivers, you can let your imagination run free.

XC-4262

\$89.95

ARDUINO EXPERIMENTER'S KIT

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TS-1652

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SOLDERING STARTER KIT

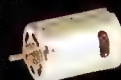
Jaycar has a complete range of tools and accessories to suit your project needs, and this makes us your one-stop-shop for Arduino. This soldering starter kit includes a soldering iron, de-soldering tool, spare tips, lead free solder, digital multimeter, screwdrivers, cutters and pliers.



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YM-2712

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DC MOTOR

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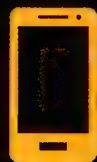
WC-6021/WC-6022

\$3.95ea

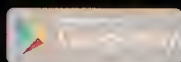
JUMPER LEADS

Jumper lead sets for use in Arduino projects.

WC-6021 Plug to Socket/Socket to Socket 10Pk
WC-6022 Plug to Plug 10Pk



VIA FREE BLUETERM APP
ON GOOGLE PLAY

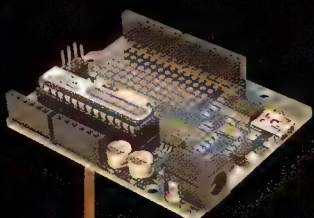


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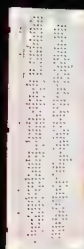


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- 200 Distribution holes
- 640 Terminal holes
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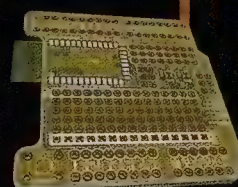


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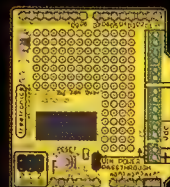


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BRING YOUR IDEAS TO LIFE

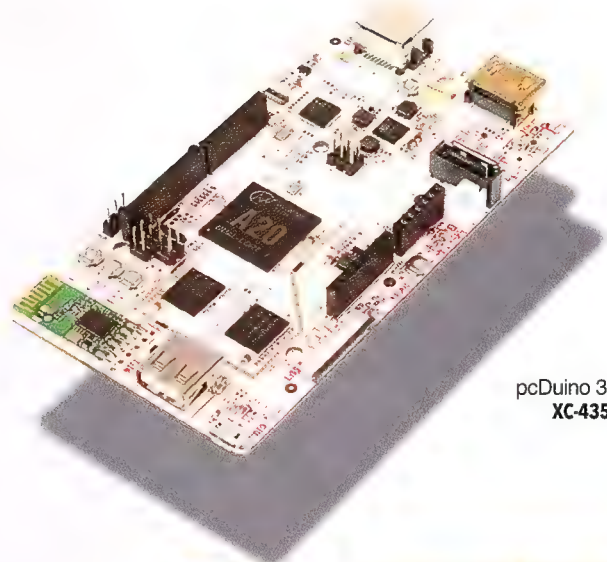
ARDUINO HAS A NEW FRIEND MEET PCDUINO

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pcDuino 3B
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XC-4352 PCDUINO NANO

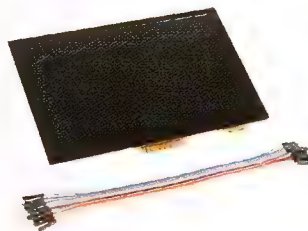
XC-4350 PCDUINO 3B

SoC	All Winner A20	All Winner A20
CPU	1GHz ARM Cortex A7 Dual Core	1GHz ARM Cortex A7 Dual Core
GPU	OpenGL ES2.0 OpenVG 1.1 Mali 400 core	OpenGL ES2.0 OpenVG 1.1 Mali 400 core
SDRAM	1GB	1GB
Flash Memory	4GB Flash	4GB Flash
Memory Expansion	microSD up to 32GB	microSD up to 32GB
Video Connection	HDMI 1.4	HDMI 1.4, LVDS
Audio Output	3.5mm Analogue	3.5mm Analogue I2S Stereo Digital
Onboard OS	Ubuntu 12.04	Ubuntu 12.04
Supported OS	Android 4.2 (ICS) / Linux 3.0	Android 4.2 (ICS) / Linux 3.0
Extension Interface	Arduino	Arduino
Network Interface	10M/100Mbps/1Gbps	10M/100Mbps/1Gbps Built-in Wi-Fi
USB Ports	2 x USB 2.0 & 1 x USB OTG	2 x USB 2.0 & 1 x USB OTG
SATA	SATA Host Socket	SATA Host Socket
Power	5V, 2000mA	5V, 2000mA
Size	96 x 60mm	121 x 65mm
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XC-4356

7" COLOUR LCD SCREEN WITH TOUCH SUITS PCDUINO 3B XC-4350

Screen	7" LCD
Connection	LVDS
Touch Screen Type	Capacitive
Resolution	1024 x 600
RRP	\$129.00



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If you think you can outsmart the others or your ingenious creation is simply too good to be missed, we want to see it. We might just publish your masterpiece right here on APC. Talk to us: onboard@jaycar.com.au

Java part 5 – mad about methods

This month, Darren Yates continues his Java masterclass, introducing the concept of methods.

Reusing code is one of the most important concepts in modern programming – the last thing you want to do is continually reinvent the wheel and we started considering this idea last time in our look at loops.

But there is a more powerful option that makes better use of those code blocks called 'methods'. Methods are a major part of Java and are used extensively within Java itself. They make life much easier because they provide a single location of code that can be reused almost anywhere, anytime in your programs.

SIMPLE EXAMPLE

Say we want to calculate the sum of integers (whole numbers) from one to a number the user decides, so, for example, the sum to five would be $1 + 2 + 3 + 4 + 5$, which equals 15. Now if you've been following this series, you may recognise that it could be done with a simple loop:

```
system.out.print("Sum to
what number: ");
int number = input.nextInt();
int total = 0;
for (int x = 1; x <= number;
x++) {
    total = total + x;
}
System.out.println("The sum
of integers to " + number + "
is " + total);
```

The problem is, if we need to do this multiple times during our program, we'd need to create a for-loop each time with the same set of commands. Not only is that a pain, it's also just inviting new bugs into your code – no matter how good you are, the more code you write, the more bugs you create. Instead, a method allows us to define a code block once and reuse it almost any time. Here's how we can rewrite part of the above code using a method:

```
static int sum (int number) {
    int total = 0;
    for (int x = 1; x <= number;
x++) {
        total += x;
```

```
1 package sumnumber;
2
3 import java.util.Scanner;
4
5 public class SumNumber {
6     public static void main(String[] args) {
7         Scanner input = new Scanner (System.in);
8         System.out.print("Enter integer to sum : ");
9         int usernum = input.nextInt();
10        System.out.println("Sum of integers to " + usernum + " is " + sum(usernum));
11    }
12
13    static int sum (int num) {
14        return ( num * (num + 1)) / 2;
```

1 The ancient Greeks
1 figured out a simple way
1 to sum integer numbers.
18

```
}
return total;
}
```

Let's look at what's happening here. If you remember earlier in this series, we talked briefly about the idea that coding uses a basic IPO concept – input, process, output. We take an input, process it and post an output. A method can do the same thing.

The first line of this particular method (known as the 'header') starts with a 'static int' – we'll talk more about the static keyword or 'modifier' in a coming issue, but the int indicates the output or return data type of the method is an integer. Now a method doesn't have to return an output – it can simply display something on the screen, for example. In that case, the return data type is 'void' because there is nothing to return.

Next, we add the name of the method – you've got good latitude for names, except certain Java reserved and keywords. (We'll cover a couple of special exception cases called 'overload' and 'override' in an upcoming issue.)

METHOD INPUT VARIABLES

After that, you provide an opening parentheses '(' and add in your input data types – these are your input variables and they always start by type, followed by name, so in our example we have an integer data type (int) called number. Input parameters

The Enigma Cipher Machine was a complex substitution cipher box.





are optional too – if you don't have any, you just provide the parentheses '()'. Now the trickiest thing here is that the number variable isn't used outside of this method, so you might think 'how on earth do I get my data into the number variable?' It's a good question and we'll answer it in a tick.

If you look at the rest of the method, you'll see we've just copied the for-loop from the original code – the only difference is the last line with the 'return' command followed by the variable holding the integer value we

want as the output of the method. Now with our brand new method in place, we can rewrite the original code like this:

```
system.out.print("Sum to
which number: ");
int usernum = input.
nextInt();
int result = sum(usernum);
system.out.println("The sum
of integers to " + usernum + "
is " + result);
```

Methods allow us to hide function code out of the way of the main code, making the whole program easier to read. But we could shrink this down further – because all we're doing is displaying the result on the screen in a println statement, we can ditch the result variable and incorporate the method call in the println line:

```
system.out.print("Sum to
which number: ");
int usernum = input.
nextInt();
system.out.println( "The sum
of integers to " + usernum + "
is " + sum(usernum) );
```

To be honest, my sum method is a shocker. Let's say we want to sum the integers up to one million – that's one million loops that have to be performed. Yuck! Summing integers like this to a known integer is called a 'partial sum' and you can work out a partial sum with a brilliantly simple equation known by the ancient Greeks:

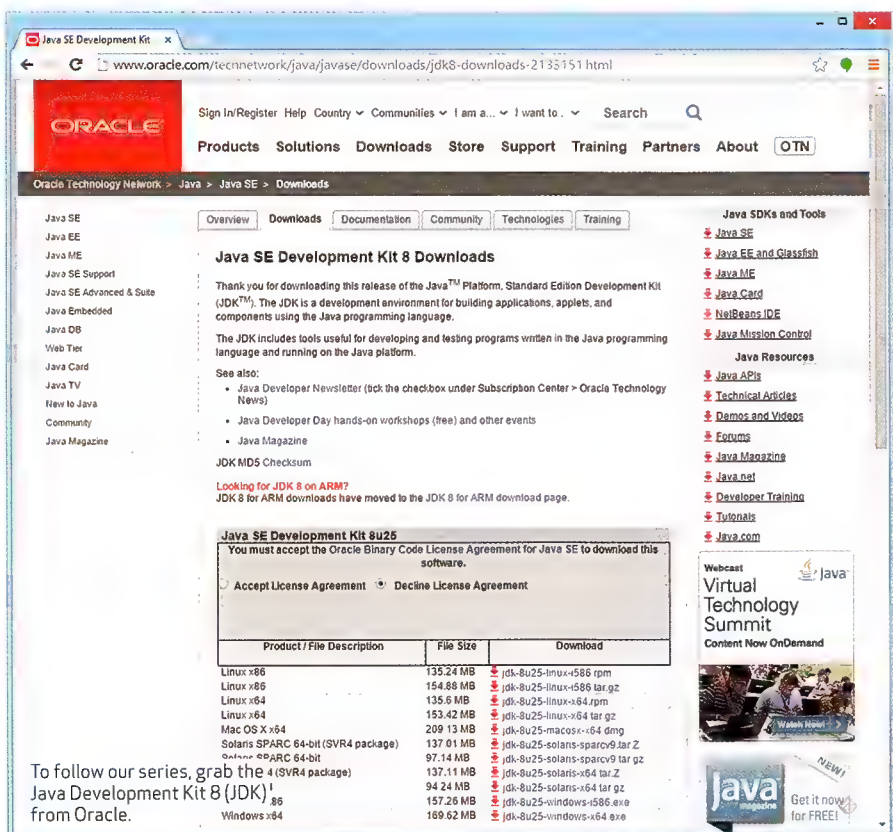
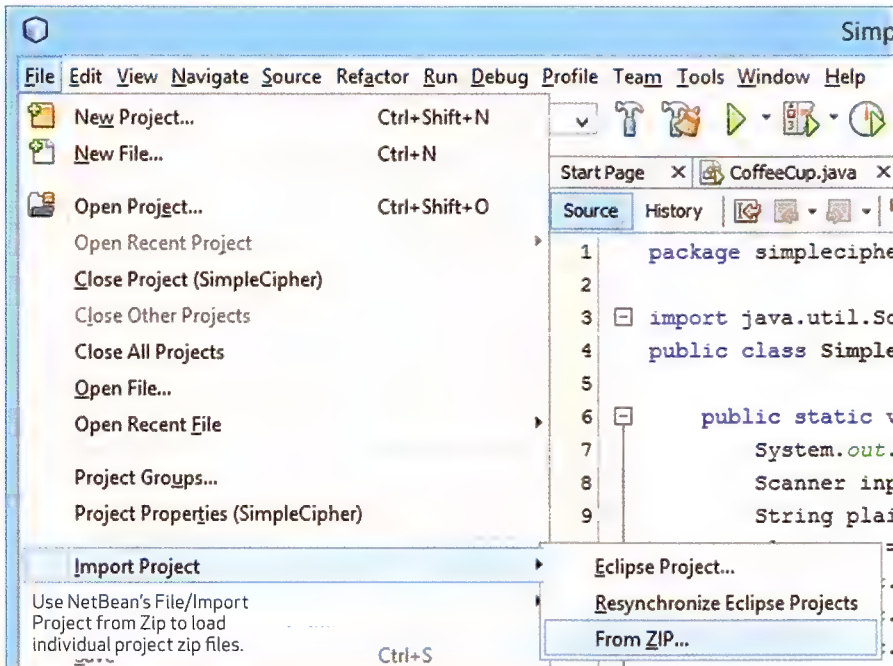
$$\text{Sum to integer 'n'} = (n \times (n + 1)) / 2$$

Right at the top, we said the sum of integers to five was 15. Let's test it out here – $(5 \times (5 + 1)) / 2 = 30 / 2 = 15$. So, we can rewrite our sum method like this:

```
static int sum (int number) {
return ( number * (number +
1) ) / 2;
}
```

This is really cool – instead of a million loops, we now calculate the sum in one step. Damn, you've got to love maths and those ancient Greeks! Now also notice what else we did – we calculated the whole function on the return codeline. Yep, Java is clever enough to see this as a calculation to be made and since the result is an integer, accept it as the return value.

Now remember that question from before? Java maps input data to a method variable in the same order it is given in the method call. For example, if we had the method header `sum(int v1, int v2, double v3)`, calling it with `sum(3, 6, 2.45)` would see the integer '3'



Build an Arduino Enigma Machine. Details, tinyurl.com/apcenigma



Method header

The general form of the method header used in our SimpleCipher.

modifier **method name** **input parameters**

static String encode (String text) {

return datatype **type name**

loaded into variable v1, '6' into v2 and '2.45' into v3. In our example, we're mapping a variable, so the value inside usernum maps to the sum method's number variable. The key for any method data exchange is that you must use the all input datatypes declared in the method header and all input datatypes between the method call and method header must match – otherwise, you'll get a syntax error.

CODE FLOW

You can find the 'PartialSum' project source code in this month's download, but the code flow works like this – it

runs down the main method until it gets to the final 'system.out.println' codeline where it sees the call to the sum method at the end. It pauses, flow passes to the sum method and when the method completes, the output (and code flow) is returned to the calling line and the result is on the screen.

Methods are totally invaluable and you'll end up using them like there's no tomorrow. Let's try another one.

CRYPTOGRAPHY

I love cryptography – the science of encrypting and decrypting data (I designed an Enigma Cipher Machine

out of Arduino you can build yourself at apcmag.com/arduino-projects-enigma-cipher-machine.htm) and we now have enough toys in the toolbox to code a simple cipher machine.

One of the simplest ciphers is the 'Monoalphabetic Substitution Cipher' where each letter of the alphabet is swapped with another. The easiest option, programmatically, is to simply reverse the letters, so, 'A' becomes 'Z', 'B' becomes 'Y', 'C' becomes 'X' and so on. At the other end, 'X' becomes 'C', 'Y' becomes 'B' and 'Z' becomes 'A', so, it's symmetrical. That means if we type in our original message (called the 'plaintext'), we'll get our encoded result (ciphertext). But if we now type back in the new ciphertext into the same program, the original plaintext reappears.

You'll find the 'SimpleCipher' project also in this month's download. We won't look at its main method here – hopefully, that'll be self-explanatory by now. Instead, we'll spend the remaining time this month looking at our new encode method.

NEW TRICKS

The encode method might only be nine lines long, but it has a truckload of things going on. Here it is:

```
static String encode (String
text) {
    String ciphertext = "";
    for (int x = 0; x < text.
length(); x++) {
        char ch = (char)( 65
+ ( 90 - text.charAt(x) ) );
        if (text.charAt(x) !=
32) ciphertext += ch;
        else ciphertext += '
';
    }
    return ciphertext;
}
```

The initial encode method declaration should be straightforward – it's just like our sum method earlier except that the input and return datatypes are both strings (think of them as text). The input text goes into the 'text' variable while the return data is stored in the string variable 'ciphertext', which is initialised on the second line.

The third line starts a for-loop and the number of loops is set by the length of the string in the text variable, which we get from the function text.length(). This is just one of a number of built-in methods Java provides to manipulate strings – this one returns the number of characters in the string as an integer number.

CHAR DATATYPES

The next line gets a bit tricky, so take your time – it starts off declaring a

Output - SimpleCipher (run) X

```
run:
Type in your message to encode/decode (alphabet characters only):
Java is a great language to learn because it is so versatile

Your original message and your encoded/decoded message as follows:
JAVA IS A GREAT LANGUAGE TO LEARN BECAUSE IT IS SO VERSATILE
QZEZ RH Z TIVZG OZMTFZTV GL OVZIM YVXZFHV RG RH HL EVIHZGROV

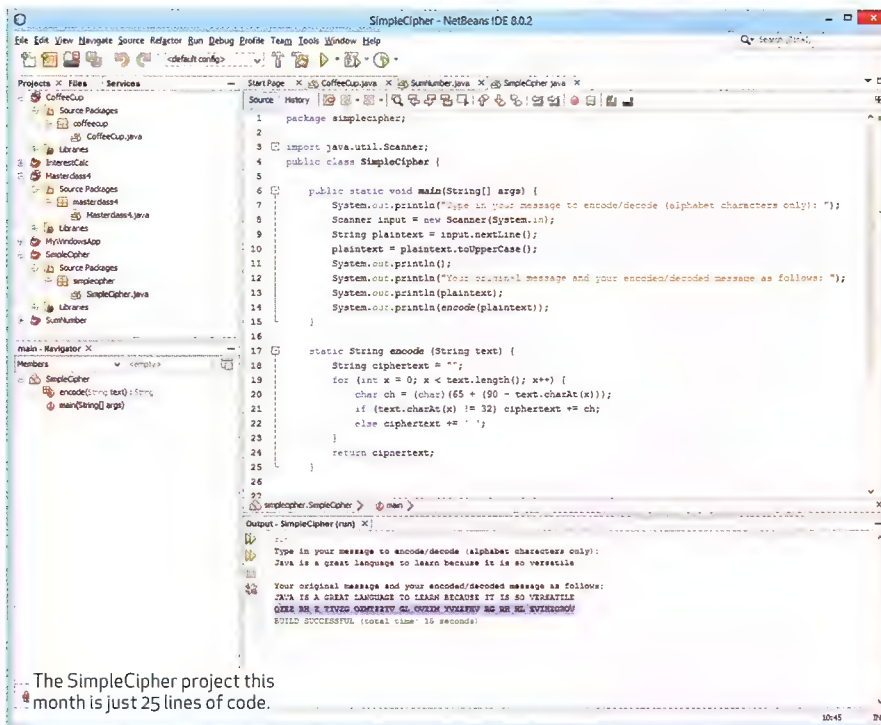
Type in your plaintext and the (total time: 15 seconds)
SimpleCipher code encodes it
for you.
```

Output - SimpleCipher (run) X

```
run:
Type in your message to encode/decode (alphabet characters only):
QZEZ RH Z TIVZG OZMTFZTV GL OVZIM YVXZFHV RG RH HL EVIHZGROV

Your original message and your encoded/decoded message as follows:
QZEZ RH Z TIVZG OZMTFZTV GL OVZIM YVXZFHV RG RH HL EVIHZGROV
JAVA IS A GREAT LANGUAGE TO LEARN BECAUSE IT IS SO VERSATILE

Type in the ciphertext and the (total time: 3 seconds)
plaintext mathematically
reappears.
```

```
( 65 + ( 90 - text.charAt(x)
) )
```

This is the heart of our encryption/decryption process. In ASCII code, the first letter of the alphabet 'A' maps to code 65, 'B' to 66 and so on to 'Z' being 90. Code processing starts with the inner brackets $(90 - \text{text.charAt}(x))$ and here, we subtract the ASCII code of the character at position 'x' from 90. So if the letter is Z, the ASCII code is 90, so $90 - 90$ is zero. This is the result of the code in the inner bracket. It's now added to 65 in the outer bracket, so we get $65 + 0$, which is 65, the ASCII code for 'A'. If the letter was A, the ASCII code is 65, so $90 - 65$ is 25. It gets added to 65 and the result is 90, the code for 'Z'.

Hopefully, you can see we're mathematically reversing the order of the characters so that 'Z' becomes 'A', 'Y' becomes 'B' and so on. Once we get this final numeric result, we cast the ASCII value into a character using the `(char)` code and store in it the character variable `ch`.

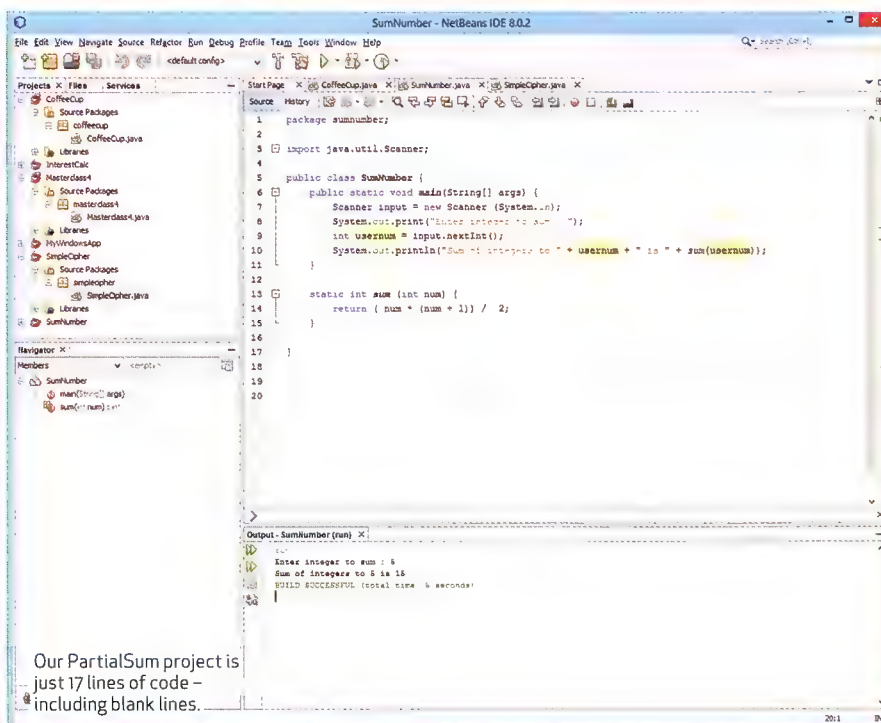
The next two lines form an if-else conditional statement and we're looking for when the character at position 'x' is a space (ASCII code 32). If the character is not a space, we add the reversed character `ch` to the ciphertext string variable, otherwise (else), we just add a space (' '). If we didn't check for the space, we'd end up with non-alphabetical characters in the output.

Finally, when the for-loop has reached the end of the plaintext, we return the ciphertext string and display it on the screen.

GIVE IT A GO

Load the source code zip file for this project into the NetBeans IDE and give it a go. If you type in 'hello world', you should get 'SVOOL DLIOW'. Run it again, type 'SVOOL DLIOW' and you'll get 'HELLO WORLD' back again. (The `plaintext.toUpperCase()` command turns any text into upper case letters before we hit the encode method).

Next month, we'll look at a special type of variable structure called 'arrays'.



character variable called `ch`. Character or 'char' variables store one alphanumeric (Unicode) character. You can assign them literally using single quote marks (' ') whereas strings are literally assigned using double-quotes (" ").

Now head to the end of the line to the `text.charAt(x)` command. This is another built-in method that returns the character at a particular location of a string and returns it as a 'char' datatype. So, if we had the string "helloworld" inside the text string variable, `text.charAt(1)` would return

the character 'e' (string positions always start at zero).

But the character datatype also has an extra trick — you can convert or 'cast' a char variable into a numeric datatype and a numeric datatype back into a char type using the standard ASCII code (www.asciitable.com). You cast a number into a character datatype by using the `char` command in brackets ('char'). You can also do maths on char types, too. You'll notice that the code immediately following the `(char)` is itself entirely enclosed in brackets:

Get the source code

You'll find the source code for this month's PartialSum and SimpleCipher projects at www.apcmag.com/magstuff.htm. Just unzip the main zip file and import the two inner zip files straight into NetBeans.

downtime

» GAMES - EDITED BY TROY COLEMAN



FROM \$89.95 | PS4, PS3 | LITTLEBIGPLANET.PLAYSTATION.COM/

LittleBigPlanet 3

Third time around and the craft works better than ever.

Anyone worried about what would happen to *LittleBigPlanet* once Media Molecule had left the building can stop: Sumo has done the Molecules proud. You'd be hard pushed to spot the difference. And it says much of the foundations laid that this continues with barely a hiccup.

The most obvious changes are the three new characters: Toggle, OddSock and Swoop, each with a specific ability – size changing, speed, and flight, respectively. They're clearly there to give the whole package a facelift, but we're not completely sold. They work, but are definitely the 'not Media Molecule' bit.

However, what the new cast do, along with several other additions, is enable the creative side of the game for more (slightly) casual players. If you have a character pre-built for speed then it's easier to make races, for example. That idea carries

through to gadgets and tools – things such as teleporters, zip-lines and jet boots now possess far more 'straight out of the box' creative potential than ever before.

Where previous LBP's relied more on taking raw components – the pistons, motors, switches and sensors – and crafting tools from them, this provides a far wider range of pre-built options. If, when asked, you decline to activate Advance Create Mode then the simplified selection makes building less daunting. Many mechanisms can largely be used as is, encouraging a more 'drag and drop' feel to making stuff.

There's a more immediate range to the space you can build into now as well. The old three-layer system has been expanded to 16, creating more literal depth to the previously 2D construction. So, even without going near cameras, character tweaks or any more involved mechanics, you can make more interesting levels straight off the bat.

The sense of accessibility is also aided through some excellent tutorials. Where previous games rattled through quick video descriptions and left you to work out the rest, this uses a mix of puzzles and gameplay to practically apply the knowledge you'll need. You'll be tweaking settings and properties to bridge gaps or reach prizes, and learning far more effectively through doing than watching. If you've never created before, or always been a little daunted by the prospect, this is probably the easiest 'in' you're going to get.

Similarly, there are new tools – such as the ability to create bespoke power-ups – that we only know about because we've had them shown to us at press events. How the average gamer is going to piece this stuff together unaided is a bit of a mystery. There's a new set of Dynamic Thermometer tools, for example. In *LBP* the Thermometer traditionally

measures the size of your level, filling up depending on the quantity and complexity of what you build. Now you can create larger levels using a Loading Linker, Preloader and Permanency Tweaker.

Obviously, the more complicated stuff is always going to require commitment, but presumably the assumption is that once you pass a certain level of complexity, you're in it for the long haul – investigating and learning, or going on forums. But it's still a surprise to see just how much you're left to fend for yourself.

The thing is, people will. If past games have proved anything, it's that the *LBP* community will think nothing of rinsing every potential opportunity and possibility from the systems at play here. However, it's an odd combination of accessible components, carefully explained, mixed with terrifyingly complex and utterly unelaborated parts.

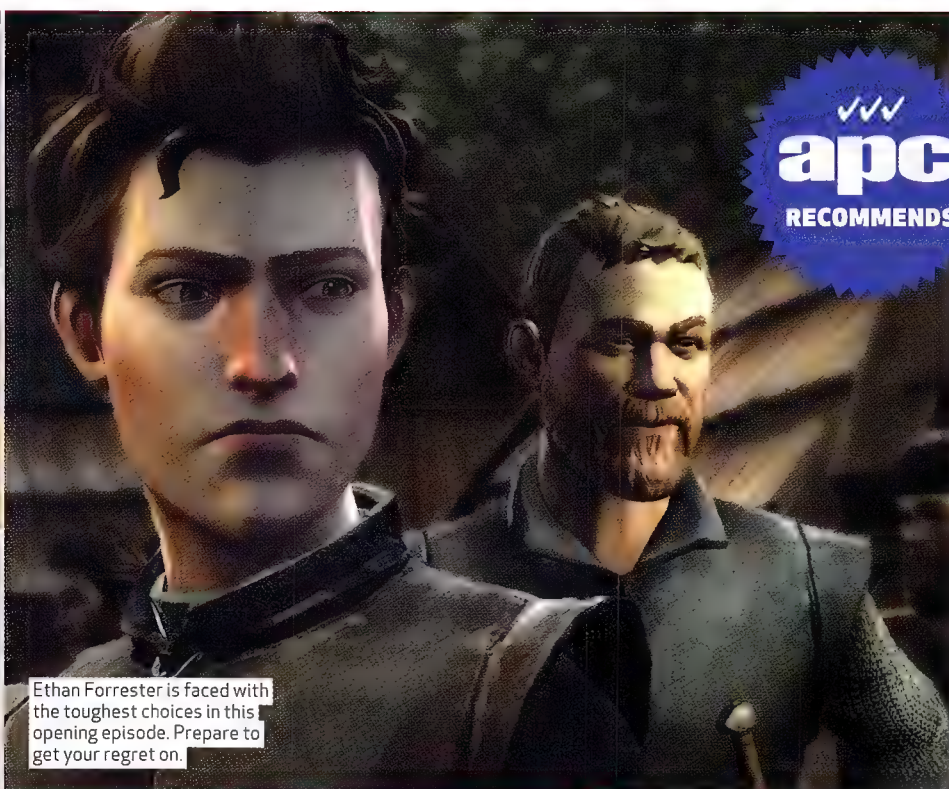
The incredibly brief story (bar a few side-missions) also puts the emphasis more than ever on individual creation and community content. It's worth noting the new tools and ideas make for some of the most enjoyable stuff to date, but the seamless integration of all the old content is also impressive, creating a huge amount of available things. It was also nice to see all our old *LBP* 1 and 2 levels imported.

This is undoubtedly the best entry in the series, giving an unparalleled creative experience on console. But it's also the most confusing. It's more accessible, terrifying, approachable and incomprehensible than ever. There's plenty of creative fun to be had, but if you're going to take it really seriously then it's going to require a lot of blood, sweat and stitches. ■ **Leon Hurley**

Verdict

If you have the time to learn it, this is a game that makes it feel like almost anything is possible.





✓✓✓
apc
RECOMMENDS

FROM US\$29.95 | PC, X1, X360, PS3, PS4 | TELLTALEGAMES.COM

Game of Thrones: Iron from Ice

"You press X, or you die..."

Living through the Red Wedding the first time was bad enough, so it's evidence of Telltale's sadistic streak that it wants us to revisit the scene of the Stark-slaying crime. In fairness, your participation during the developer's debut *Game Of Thrones* episode is slightly less harrowing, but nevertheless it gets proceedings off to quite the stern start.

Stationed outside the venue of the Bolton's butchery, *Iron From Ice* kicks-off with you in the shoes of Gared Tuttle, squire to Lord Forrester. Although not for long, as the opening sees the big man, and pretty much everyone in your camp, get brutally murdered as part of the underhanded power play. And so the events of this series are set in motion.

One thing that differentiates *Thrones* from Telltale's flagship series is the number of player characters: there will be five in total, with

this first part seeing you inhabit two more in addition to Tuttle. All are affiliated with House Forrester, and vary across the age/sex/location spectrum. They're a faction that hasn't appeared in HBO's mega-series, but the game quickly brings you up to speed: this lot have been loyal Stark bannermen for generations.

PLAYING HOUSE

Of course their fealty to Rob and co puts them at risk in the wake of the murderous marriage ceremony, and it's this that the plot centres around. The second character you control is young Ethan Forrester, thrust into the big chair following his pa's demise. His scenes are where Telltale's strengths most shine through, as you must balance the desire to stand up for your people with the reality of your situation, faced as you are with more powerful enemies. It taps into what the books and TV

show are really all about: cat-and-mouse politicking, and the transient nature of authority.

Finally (for now) you're put in the stead of Mira, handmaiden of Margaery Tyrell in King's Landing. It's here where the show's cast is most prominent, with Cersei, Tyrion and MT all voiced by their TV counterparts. Sadly the script can't match what they're used to, with several scenes throughout coming across as overly twee despite the occasionally coarse language. And this connects to the biggest problem Telltale seems set to have as it continues: the aesthetic. The aimed-for 'oil painting' look is simply too sanitised for both the atmosphere and the events unfolding, with the whole affair possessing something of a Disney sheen that just doesn't fit. This is grim, gritty, violent fantasy, not clean-cut.

That said, even this opening instalment is packed with tricky decisions to make, and

by recreating the source material's uncertain power dynamic you'll often be left wondering if you could have done things better. What also seems to be shared is a desire to shock, and scenes which will be prime spoiler-fodder for anyone so inclined. (We're nicer than that, so fear not.)

It's a slightly uncertain start then, which is both surprising given Telltale's recent track record, and not so given the magnitude of the IP being tackled. But despite some surface failings there's potential here, and the understanding of what makes *Thrones* tick should stand us in good stead for the winter to come.

■ Joel Gregory

Verdict

Issues with art style, but give us enough tough choices and drama and we'll soon stop noticing.





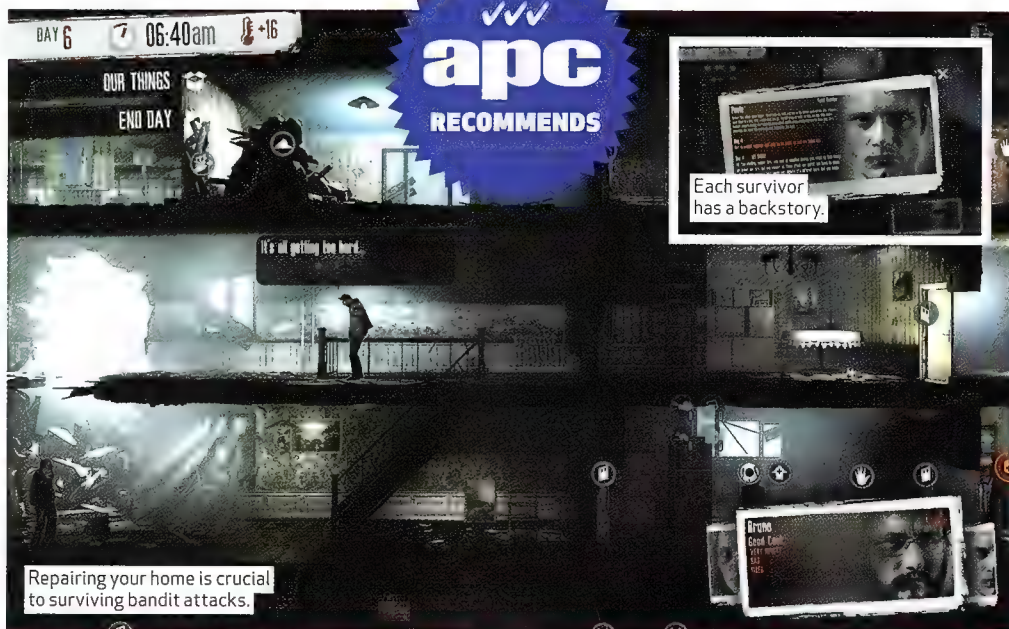
Dungeon of the Endless

Challenging crawler contains hidden depths

US\$12.95 | PC
AMPLITUDE-STUDIOS.COM

Part roguelike, part tower defence, part turn-based strategy, it contains subtle nuances that can take hours to come to light. You are trapped at the bottom of a twelve-floor dungeon. You can select two heroes at the start of a campaign, with the potential to hire two more along the way. If a hero dies, there's no bringing them back. And they will die. Each floor contains multiple rooms. Open the door to a new room, and you start a new turn. *Dungeon Of The Endless* is all about the anticipation of what's hiding behind these doors. It could be an item, a merchant or a research station. Alternatively, it could be a wave of enemies that spawn from every unlit room. To light rooms you need Dust, one of the game's four collectible resources. Eventually, you'll uncover the exit to that floor. Do so and all hell breaks loose, as every door opens, and enemies flood out of the unlit rooms. More than anything, each level is about preparing yourself for that one insane moment. *Dungeon Of The Endless* is fascinating and tense, and its strategies are gratifyingly complex. As a bizarre genre mash-up it really shouldn't work, but every system functions in harmony, and each armed us with a greater understanding of the whole. For that alone, it's an impressive achievement. It's also relentless. Taken a few floors at a time, and accepting any progress as a victory, it's a welcome challenge.

■ Phil Savage



US\$19.95 VIA STEAM | PC | 11BITSTUDIOS.COM

This War of Mine

A delicate statement on the struggles of survival.

We're watching, helplessly, the final moments of a woman who has lost the will to live. Katya returned from studying abroad to a country where people scavenge to stay alive. A few days ago Anton, formerly a teacher, died of starvation. Before him Pavel, once a star footballer, was wounded when roving bandits besieged our base. Without bandages he bled out.

Cveta, mother figure of the group, becomes sick so Katya goes in search of medicine. A nearby house has the goods, but it's home to an elderly couple. Brandishing a knife she hobbles to their bathroom as the old man desperately pleads not take his sick wife's medicine. Katya isn't a bad person, she's desperate. But it's too late anyway. Cveta dies. Depressed and starved, Katya crumbles to her knees. We frantically click the tinned food icon hoping she'll eat, but she ignores our commands.

This War of Mine explores the harrowing realities of living amid conflict. Its resource management,

life-sim and exploration game mechanics are simple, but they elegantly drive home their message: in modern war, you will die like a dog.

Each day plays out in two phases. In the light, snipers confine your characters to a musty building. As in a grim version of *The Sims*, you click to assign your people tasks,

Whether pillaging an abandoned house or risking all in a fortified hotel, there's a feeling it could all go wrong in the blink of an eye.

When desperate children plead for food, turning them away impacts your characters' mental state, making them depressed, even suicidal. It's common to find a character

"Your characters are fragile, weapons are difficult to come by. You never feel safe."

such as making food, building stuff, clearing rubble or administering first aid.

Resources are gathered at night when one character scavenges while others stand guard. Locations include abandoned schools, hospitals and churches. Walking is silent but slow, while running comes at the risk of making noise. There's real tension.

has hung himself.

This War of Mine is one the most interesting games of the year, but it's also very difficult to play. Its world always has its boot to your throat, slowly upping the pressure until the life is drained from you. There's no happy ending, and that's the point.

■ Tamoor Hussain

HARSH REALITIES

Defenceless NPCs cower, others barter, still others respond with deadly force. Your characters are fragile, weapons are difficult to come by. You never feel safe.

Verdict

Hugely atmospheric; great stealth mechanics; intelligent but the cruelty is a bit of a mood killer.





FROM US\$15 | PC, X1, X360, PS3, PS4 | SIERRA.COM

Geometry Wars 3: Dimensions

Rumours of the series' death were greatly exaggerated.

When Activision closed Bizarre Creations in 2011, it looked like an untimely end for *Geometry Wars* also. There were tears. Tantrums. Shouting from mountaintops into an uncaring sky because the end of the world had come. But someone somewhere must've pressed the restart button, because the series has respawned under the also-thought-dead Sierra name. Cue angelic chorus and apologies to the sky for being such a prat. This should be amazing.

Sure enough, the core experience remains one of the most beautifully crystalline twin-stick shooters available, with only a screen-clearing smart bomb and a pre-determined special move to worry about besides navigating and blasting. But more so than in any other game in the series, there is immeasurable extra depth and complexity waiting for you, if you choose to explore it.

The first twist – quite literally – is the hint of a third dimension to the top-down, 2D gameplay. Mercifully you never need to

worry about height as everything happens on the same flat plane as you, but the levels themselves are now distorted into 3D realms.

Sometimes that means spherical worlds you might be defending from a virus, or capsule-shaped objects that are being coloured in by evil paint rollers. Crucially, all of the new features are used sparingly. You always have one clear set of rules to contend with, served in a bite-sized, highly-replayable package. It's just that now there are 50 such configurations to play in single-player, each with its own leaderboard.

EARN YOUR STARS

High scores are all-important. Not only are your friends' records displayed before, during and after every level, there are three stars to earn in each event. The sense of progression is delicious, and winning all 150 may take over your life. The drones threaten to over-egg the Pythagorean pudding, but after a while they become an integral part of your game plan. One always follows you around, either picking up score multiplier geoms, or helping

you blast things. The tactical depth opens up as you unlock new ones, but this also creates a problem the series has never had before.

With score competition such a big part of the game, it's disappointing to learn that revisiting early levels with an upgraded drone allows you to easily double your initial tally. That means until everyone has unlocked everything, score battles are likely to be won by the player with the best drone. And bought victories are shallow.

The five beautifully uncomplicated main modes of *GW2* are all available as an added bonus, and they are still as close to perfect as you remember. It's great to play them on PS4 or XO but they highlight the fact that the new content, despite its fantastic design and pacing, is only 'almost' as good as *Geometry Wars 2*. Sometimes equal... but never better.

■ Justin Towell

Verdict

Gorgeous, compulsive shooting action with incredible depth, but the score battles can be mismatched.



Framed

A noir thriller in comic-book form, where you dictate the outcome

\$4.99 | IOS
FRAMED-GAME.COM

With an App Store drowning in me-too puzzle games ('Fling a thing across the thing to earn things!'), it's always a joy when developers do something different. *Framed* manages to give you something unique and ambitious, while also delivering a style of gameplay that's immediately accessible and intuitive. The basic premise is to rearrange the panels of a comic book, thereby changing the outcome of a story that's playing out before your very eyes. We've seen the odd puzzler vaguely along these lines on iOS before, but nothing with anywhere approaching the same class, attention to detail and smart thinking that's evident all the way through *Framed*. Much of this is down to clever storytelling. You're not some generic stickman leaping about platforms, but a spy immersed in espionage and on the run from the cops. Hit play and the comic comes alive, silhouette figures moving from panel to panel, until the spy is caught or escapes. By adjusting their order the narrative changes, improving the briefcase-wielding spy's fortunes. The only snag is it's over fairly quickly, but five buck's a small price to pay for a gorgeous, experimental iOS gaming experience.

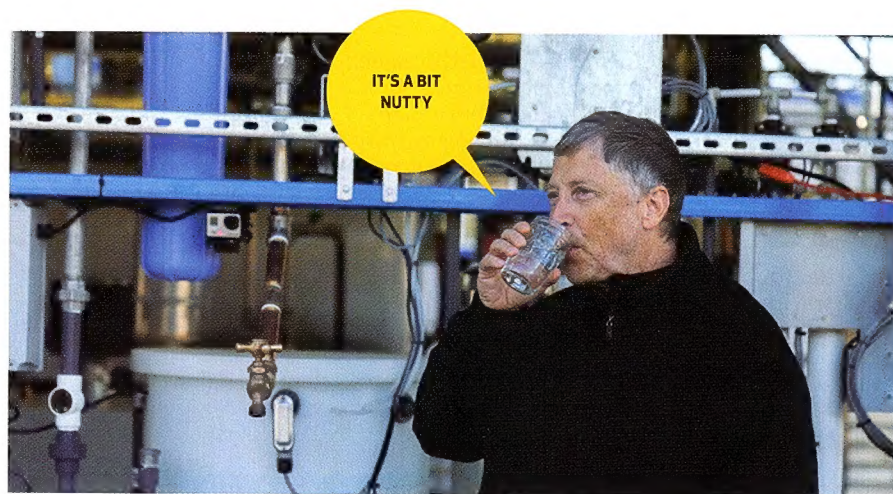
■ Craig Grannell



Does my butt look big?

Plastered all over social networks, we'd say yes.

Sure, we'll begrudgingly accept that the selfie stick has become an accepted norm — at the very least, it's a great way to spot people with shallow and narcissistic personalities. (We kid!...) But what about your inner Kardashian? You know, the one that wants to 'break the internet' with photos of your luscious booty. Fear not, for a company has created what it's creatively named the 'Belfie' — a selfie stick with a hinge that'll allow you to take endless, stress-free 'butt selfies'. While this is truly a revolutionary product, it's important to note that instructions for twerking are not included.



DRINKING THE KOOL-AID

While the internet is undeniably a font of wonderful weirdness, we must admit that one thing we didn't expect to see on it was Microsoft founder Bill Gates drinking water that was extracted from human waste. The video, which showed up online in early January, was created to promote Gates' ongoing commitment to the issue of sanitation in developing countries, with Gates' performing the stunt in an attempt to 'flush' away any hesitations that the public may feel towards drinking what's known as 'blackwater'. They might want to get some marketing people onto rebranding that one...

WORTH THE WAIST?

Reinventing the...belt? With the developed world's obesity levels growing, it's perhaps a sign of the times that someone has revolutionised the belt. Meet Bely — a motorised smart belt that was unveiled during this year's CES. Unlike other 'dumb' belts, Bely is designed to automatically tighten or loosen depending on whether you're standing or sitting. The prototype houses a range of sensors, including an accelerometer that's able to track exercise, while a mobile app keeps tabs on your waistline, ensuring you're able to see your waist slowly expand with every mouthful.



Charge up your exercise routine

While other smart watches attempt to motivate you to exercise through flashing lights and gentle vibrations, the Pavlok promises to get you moving by using good old fashion pain. The Pavlok is a wristband with the unique capability of delivering electric shocks ranging from 17 to 340 volts to its wearer, with the product set to be released in May following a successful campaign on crowdfunding site Indiegogo. Through the mobile app, users can set goals — such as to go to the gym more often or avoid visiting social media sites while at work — which the wristwatch then monitors to ensure you follow through; and if you don't, the device will deliver an electric shock directly to your body. While the Pavlok may seem like a little bit of harmless fun, those with pacemakers or other heart conditions should probably avoid it...

iiNet takes a chill pill

In one of those 'only in Australia' moments, a recent heat wave in Perth caused ISP iiNet to 'take five', shutting down internet services across the country and leaving thousands of customers unable to access the 'net for over six hours. The company explained that the move was made as a precaution, with a number of systems in its Perth data centre being taken offline after temperatures exceeded 40°C. The response from social media was quick to criticise the company, complaining about a lack of preparedness for something that regularly occurs within Australia. Some even jokingly suggested that the company install backup air-conditioners in order to prevent this 'random' incident from happening again. ■

iinet
connect better

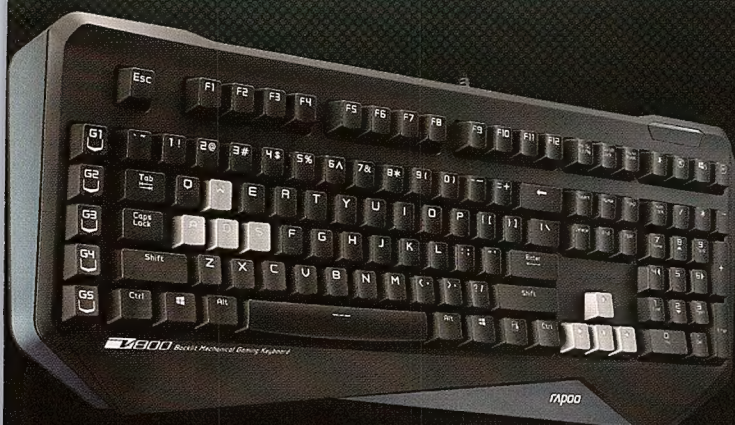


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